Demand Reduction Analysis
for
Aberdeen Proving Grounds

Aberdeen, Maryland

Final Submission

Performed by

ENTECH

Entech Engineering, Inc.
Reading, Pennsylvania

June 1996

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ABERDEEN PROVING GROUNDS
DEMAND REDUCTION ANALYSIS

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1.0 EXECUTIVE SUMMARY

1.1 Project Authorization and Objectives

This project was authorized under the general provisions of Executive Order 12902 with specific implementation under the Army's Energy Engineering Analysis Program (EEAP). Entech Engineering, Inc. was commissioned under Contract DACA01-94-D-0037, Delivery Order 0010 issued by USAED, Mobile and Administered by USAED, Baltimore (Ted Gross). The objectives of the project are to research, identify, evaluate, and define energy saving projects that meet the Army's criteria and lead to energy savings at the Aberdeen Proving Grounds, Aberdeen campus, with respect to electrical demand reduction. Details of the authorization and objectives of this report, which delineates our contractual arrangement with the government, may be found in Section 8.11.

1.2 Synopsis of Findings

Entech Engineering, Inc. metered the Post at the substation level to provide some definition to the $7,000,000 annual electric cost consumed by the 19,500 people who occupy over 1,700 buildings and 13 million square feet on Post. Overall, Entech considered means of reducing the demand portion of the electrical cost estimated at over $2,900,000 per year.

A total of fourteen (14) Energy Conservation Opportunities (ECOs) were developed and evaluated. ECOs describe the means to reduce energy consumption and operating cost. Of the fourteen (14) ECOs, six (6) have been developed as economically feasible. The remaining eight (8) investigated did not prove to be economically attractive. Table 1.2.1 on the following page displays a summary of all ECOs investigated, prioritized by SIR.

Table 1.2.1, Summary of ECOs, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*
6	Peak Shaving with Emergency Generators	$1,100	$14,800	0.1	111.1
5	BG&E's Curtailment Service Rider	$4,900,000	$1,800,000	2.7	4.9
2	Upgrading Substation 4 & 9	$520,000	$140,000	3.7	3.6
3	Upgrading Substation 18	$1,500,000	$350,000	4.3	3.1
1A	New 115 kV Substation - 1 Transformer	$2,700,000	$585,000	4.6	2.9
1	New 115 kV Substation - 2 Transformers	$4,100,000	$585,000	7.0	1.9
8	Disable or Redirect Sensor for Doors	$240	$30	8.0	1.7
7	Electric Clothes Dryers to Natural Gas	$79,000	$10,100	7.8	1.3
12	Building 314 Ice Storage System	$340,000	$30,000	11.3	1.2
10	Electric Dryers to Gas - Includes New Dryers	$177,000	$10,100	17.5	0.6
13	Building 5046 Ice Storage System	$343,000	$13,000	26.4	0.1
11	Add Insulation to Freezer Wall	$10,500	$100	105.0	0.1
4	Emergency Generation Rider	$0	$11,700	0.0	0.0
9	Limit Use of Underfloor Warming System	$0	$1,800	0.0	0.0

In summary, a total of six (6) Energy Conservation Opportunities (ECO) have been recommended for implementation out of the fourteen (14) identified in this report. The ECOs were then categorized into one of five types of project. The five include:

1. Recommended ECIP
2. Recommended Non-ECIP General projects
3. Recommended Non-ECIP O&M projects
4. Recommended Non-ECIP LC/NC projects
5. Non-Feasible

The criteria used to place the ECOs into these categories is detailed in Section 7.0. Of those, only two were considered to be eligible for ECIP designation, as shown in the table below

Table 1.2.2, Recommended ECIP Projects, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*
5	BG&E's Curtailment Service Rider	$4,900,000	$1,800,000	2.7	4.9
1	New 115 kV Substation - 2 Transformers	$4,100,000	$585,000	7.0	1.9
	Totals	$9,000,000	$2,385,000	3.8	

The remaining four (4) ECOs that are recommended include one (1) Non-ECIP general projects and three (3) Non-ECIP low cost/no cost (LC/NC) projects. All tables are shown in the following tables. There are no recommended Non-ECIP O&M projects.

Table 1.2.3, Recommended Non-ECIP General Projects, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*
7	Electric Clothes Dryers to Natural Gas	$79,000	$10,100	7.8	1.3

Table 1.2.4, Recommended Non-ECIP O&M Projects, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*

Table 1.2.5, Recommended Non-ECIP LC/NC Projects, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*
6	Peak Shaving with Emergency Generators	$1,100	$14,800	0.1	111.1
8	Disable or Redirect Sensor for Doors	$240	$30	8.0	1.7
9	Limit Use of Underfloor Warming System	$0	$1,800	0.0	0.0
	Totals	$1,340	$16,630	0.1	

Depending on which ECOs are implemented, it is believed total energy cost savings realized could be over $2.4 million per year. This will be a reduction of 34% of the total electric cost and a 24% reduction in total energy costs.

The non-recommended alternatives are listed below in Table 1.2.6. The eight (8) non-feasible ECOs have a payback period over 10 years or an SIR below 1.25.

Table 1.2.6, Non-Feasible Projects, Prioritized by SIR

ECO #	*ECO Description*	*Construction Cost*	*Energy & Maint. Savings*	*Payback Period (yrs)*	*SIR*
1A	New 115 kV Substation - 1 Transformer	$2,700,000	$585,000	4.6	2.9
2	Upgrading Substation 4 & 9	$520,000	$140,000	3.7	3.6
3	Upgrading Substation 18	$1,500,000	$350,000	4.3	3.1
4	Emergency Generation Rider	$0	$11,700	0.0	0.0
12	Building 314 Ice Storage System	$340,000	$30,000	11.3	1.2
10	Electric Dryers to Gas - Includes New Dryers	$177,000	$10,100	17.5	0.6
13	Building 5046 Ice Storage System	$343,000	$13,000	26.4	0.1
11	Add Insulation to Freezer Wall	$10,500	$100	105.0	0.1

The following sections of this report describe in detail the findings as outlined above and contain the necessary cost estimate and calculation backup data as required. The reader is encouraged to carefully review each of the following report sections to understand the assumptions, methodology, and discussions involved.

2.0 METHODOLOGY

2.1 General

The intention of this report is to assess the Post's current energy consumption and provide recommendations to reduce electrical demand. Entech has developed a thorough format which is adhered to during the development of an energy report. This format has permitted Entech to construct comprehensive reports in a smooth and timely process.

The following is a listing of the components in Entech's methodology for completing energy related studies:

1. Data Collection/Initial Review
2. Site Inspection
3. Model Existing Energy Consumption
4. Energy Conservation Opportunities
5. Draft Report
6. Client Review
7. Final Report Generation

2.2 Data Collection/Initial Review

Consistent with the Scope of Work, copies of the following documents were requested:

1. DAIM-FDF-U letter dated 10-Jan-94, "Energy Conservation Investment Program (ECIP) Guidance"

2. Architectural and Engineering Instructions (AEI)

Copies of the following documents were also requested:

3. Drawings, Substation and Feeder Data

4. Building Information Schedule (BIS)

5. Copies of the previous two years electric bills

6. Copies of the previous two years use for non-electric utilities

7. Rate structures for non-electric utilities

8. Basic informational map of Aberdeen roads and buildings.

9. Any recent demand profiles indicative of the routine use patterns.

10. CADD file of Aberdeen informational map.

11. Copies of drawings for the following buildings:
3660, 314, 5046, 4117-4120, 4216-4220, 4210-4220, 4306-4309, 4316-4317.

12. Copy of Ten Year Infrastructure Stabilization Plan FY 95-04.

13. Copy of Annual Work Plan FY 95.

14. Informal BGE report on Privatization

15. Listing of emergency generator locations

16. Listing of projects under design and construction.

Generally, the above documents have not been reproduced as part of this report.

The electric utility company serving the base, Baltimore Gas and Electric Co. (BG&E), furnished the following data:

1. Rate Schedules
2. Incentive Programs available for Reducing Demand.
3. Electric Demand Profiles

2.3 Site Inspection

Entech Engineering, Inc. investigated electrical consumption by examining the electric bills and by review of the utility demand consumption profiles.

Entech engaged a testing agency to preform on-site testing of the electrical system. The agency connected Dranetz 808 electric demand meters to the active feeders leaving the substations.

The data was inserted into an spreadsheet, summarized and profiles were drawn for comparison. In cases where readings were missing, data was inserted to correspond both to the overall base profile and the readings adjoining the missing data. Inserted data appears in a different typeface.

In parallel with the testing agencies efforts, the Energy Officer was asked to survey the general base population and endeavor to identify any testing activity that could distort the results because of abnormal electrical consumption. No aberrations were reported.

Entech also acquired electric use profiles from the Baltimore Gas and Electric Company meter for the entire test period and used that data for comparison.

2.4 Model Existing Energy Consumption

2.4.1 Feeder Selection

In order to capture some potentially attractive energy/cost saving opportunities that exist on a base-wide basis the main feeder from the utility company was selected for investigation. This feeder allowed

Entech to consider different purchasing arrangements, rate structures, and/or generation opportunities.

Entech then mapped the heavy power distribution (13.2 kV and above) on a copy of a generalized Base map and charted the approximate service areas of each substation feeder. This information was reviewed in concert with the readings to locate the large consumers as well as those portions of the installation which consumed disproportional amounts during one of the peak demand periods. The new gas main was also located on the map so that an alternative source of energy would available to fuel any consumers considered for curtailment from the electrical system.

Entech further limited the search by focusing on areas of the post where field investigation time would be limited; thereby permitting additional engineering time to be applied toward finding/demonstrating legitimate opportunities. After touring the Post and reviewing certain engineering data, Entech developed a listing of potential study areas with rough projections of the probability of a demand saving project emerging from the study. From this listing, the Corp selected the areas for this study based upon its potential to yield a project. The sole exception to this was an instance where a large study effort with a high project potential was already under contract with another A/E as part of a rehabilitation project. The table on the following page indicates the selected areas of study.

Aberdeen Proving Grounds ECO Selection List

Recommended Demand Reduction ECO	*Location of Study*	*Probability*	*Cost to Investigate*	*Remarks*
Own the 115 kV to 34.5 kV transformation	System	100%	95	Partial project underway
Exercise emergency generators	System	80%	80	
New Emergency Generators	System	40%	50	Curtailment Rider
Storage system and/or generation	5046	65%	100	
Storage system and/or generation	314	70%	100	
Cooling Technology	3660	?	50	Large Load no Data
Peak Shaving with existing generator	3660	60%	35	
Post hours of Operation	System	?	30	Electrical savings only
Cooking, dryers, hot water	4117-4120 4216-4220	75%	90	
Cooking, dryers, hot water	4210-4213 4306-4309 4316-4317	70%	100	
Re-meter Base	All Subs	N/A	350	Different Schedule

Aberdeen Proving Grounds ECO Non-Selection List

Non-Recommended Demand Reduction ECO	*Location of Study*	*Probability*	*Cost to Investigate*	*Remarks*
Co-Generation Project	Sub 9	40%	225	Demand Avoidance
Storage System	2401	60%	75	
Storage System	5016	40%	75	
Heating, cooling, dryers, cooking	Sub 25 & 31	90%	450	Parallel project in design
Storage system	5014	40%	75	
Motor Loads	5014	10%	60	Big off peak load

2.4.2 Electric Rate Analysis

Entech extracted rate information from BG&E's published rate structures and riders and simulated the BG&E billing system in a spreadsheet model. The model performance was tested against actual bills so that imputing monthly meter reading data, will result in a determination of the cost of the electric service within 0.5% of the utilities invoice.

From this model, Entech is able to mathematically derive the incremental costs for both usage ($/kWh) and demand charges ($/kW) per unit of measure. These determinations can then be used to generate the electrical cost differential of the various ECOs.

2.4.3 Energy Values

The following energy values and cost have been used in the energy calculations in this report.

Table 2.4.3.1, mmBtu Units

Fuel Type	*mmBtu/Unit*	*Cost/mmBtu*
Electricity (kWh)	3,413	$15.90
Natural Gas (mcf)	1,031,000	$5.11
Steam (lbs)	1,340	
#2 Fuel Oil	138,700	$5.05
Propane (gal)	95,000	
Bituminous Coal (ton)	24,580,000	
Anthracite Coal (ton)	25,400,000	

2.5 Energy Conservation Opportunities (ECOs)

After the feeder selections were finalized, Entech began to analyze the ECO ideas which were developed during the site inspection. An ECO describes an idea for decreasing costs. Each ECO evaluates a current situation against a proposed improvement and presents an analysis based upon energy, maintenance, and capital costs. The write up consists of the following sections:

1. Existing Condition Description
2. Proposed Condition Description
3. Implementation Cost Estimate
4. Energy Savings
5. Maintenance Cost/Savings
6. Discussion
7. Life Cycle Cost Analysis Summary

2.5.1 Existing Condition Description

A general description of the existing condition will be provided as well as current annual electric demand, usage, and cost.

2.5.2 Proposed Condition Description

This section presents the proposed concept to save demand costs. Since it is a concept, no actual design has been performed. The quantity of energy for the proposed system is determined by matching the existing consumption.

The proposed demand reducing systems incorporate existing system functions. Should the ECO progresses to the design phase, the design engineer will need to take into detailed account the activity in the space, characteristics of the tasks performed in the space, energy savings that

may be captured in parallel with demand reduction, other operations and maintenance issues related to the project, along with current codes and standards.

2.5.3 Implementation Cost Estimate

The estimated cost for implementing the project. The cost estimates are broken down into material, labor, and engineering components. The cost figures are based on manufacturer furnished quotes and/or Means Cost Data 1995, 18th annual edition.

The cost estimates prepared for this study are considered to be "conceptual" in nature. They are conceptual because they are based upon engineering design that is less than 1% of a complete detailed design effort required for such a project.

The final results of a project can vary significantly from the "conceptual" cost estimate. The American Association of Cost Engineers (ACE) generally states an accuracy range of plus or minus 20% for "conceptual" cost estimates. Variations beyond this range are possible for the stated scope, but not likely.

Since it is not possible for the consultants to know the most likely variations that can occur in the future, nor can it control certain technologies, contractors, or general economic conditions, the costs estimated herein should not be construed as fixed or precise.

2.5.4 Energy Savings

This section of the ECO write up compares the existing and proposed energy demand, usage, cost, and any usage savings in mmBtu/yr are calculated. The savings shown is an expected level of annual savings which does not include price increases of various energy sources or takes into account any interactive savings. The ECOs are calculated on a stand-alone basis.

2.5.5 Maintenance Costs/Savings

This section presents the proposed maintenance impact resulting from implementing the ECO.

2.5.6 Discussion

The discussion section includes the simple payback period and the Savings to Investment Ratio (SIR) from the Life Cycle Cost Analysis Summary.

2.5.7 Life Cycle Cost Analysis Summary

The life cycle cost were forecasted with the Blast: LCCID version 1.0, Level 80 Program. LCCID is an economic analysis computer program tailored to the needs of the Department of Defense (DoD). It is intended to be used as a tool in evaluation and ranking design alternatives for new and existing buildings. LCCID has built-in calculation procedures recognized as a standard for the DoD. The following is the specific criteria and other guidance embodied in LCCID according to the LCCID users manual.

The specific criteria and other guidance embodied in LCCID are:

1. Office of Management and Budget (OMBP Circular A-94, March 27, 1972. OMB Circular A-94 has a new version (October 29, 1992) but a final decision on incorporating the new circular into tri-service criteria has not been determined.

2. Code of Federal Regulations, 10 CFR 436A, January 25, 1990. Annual fuel escalation rates are published by NIST (National Institute of Standards and Technology) under sanction by DoE.

3. Memorandum of Agreement on Criteria/Standards for Economic Analysis/Life Cycle Costing for MILCON Design, 18 March 1991. This memorandum obviated the need for separate criteria in the three services (Army, Air Force, and Navy) of the Department of Defense.

4. DoD Energy Conservation Investment Program (ECIP) Guidance. This guidance uses the memorandum from Item 3, as its basis, but also has some qualifying factors for energy conservation projects and specifies its own format.

The LCCID Program is structured as shown on Table 2.5.7.2, ECIP Study LCCID Ready Reference, which can be found at the end of this section. This table was obtained from the LCCID program users manual.

The following criteria was selected/entered into the LCCID program to obtain the Life Cycle Cost Analysis Summaries prepared as part of each ECO:

A. Common criteria selected for all life cycle cost analysis summaries:

- Military Construction Army (MCA)
- User Entry of Consumption Values
- ECIP Project
- Energy Escalation Rates for FY 95 (October 94)
- English Units

B. Common criteria entered into all life cycle cost analysis summaries:

- ECIP Economic Life: Table 2.5.7.1, following page
- Location: Maryland
- Electric Usage Cost: $15.90 per mmBtu

$$\left(\frac{\$0.0543}{kWh} \ x \ \frac{kWh}{3{,}413 \ Btu} \ x \ \frac{1 \ x \ 10^6 \ Btu}{mmBtu} \right)$$

- Natural Gas Usage Cost: $5.11 per mmBtu

$$\left(\frac{\$5.26}{mcf} \ x \ \frac{mcf}{1{,}031{,}000 \ Btu} \ x \ \frac{1 \ x \ 10^6 \ Btu}{mmBtu} \right)$$

- Fuel Oil Usage Cost: $5.05 per mmBtu

$$\left(\frac{\$0.70}{gal} \ x \ \frac{gal}{138{,}700 \ Btu} \ x \ \frac{1 \ x \ 10^6 \ Btu}{mmBtu} \right)$$

- Project Number:
- Fiscal Year: 1996
- Project Title: EEAP
- Installation Name: Aberdeen Proving Grounds (APG)
- Study Preparer: SAB
- Salvage Value: $0.00

C. Criteria entered into life cycle cost analysis summaries from the ECO:

— Discrete Portion Title: ECO #
— Construction Cost: Dollars
— Design Cost: Dollars
— Supervision, Inspection, and Overhead (SIOH): Program default of 5.5% of construction cost
— Energy Savings: mmBtu
— Demand Savings: Annual Dollars
— Annual Recurring Savings: Maintenance Savings ECO Section
— Non-Recurring Savings: Maintenance Savings ECO Section

Table 2.5.7.1, Recommended Economic Analysis Life

Category	*Title*	*Years*
1	EMCS or HVAC Controls	10
2	Steam and Condensate Systems	15
3	Boiler Plant Modifications	20
4	HVAC	20
5	Weatherization	20
6	Lighting Systems	15
7	Energy Recovery Systems	20
8	Electrical Energy Systems	20
9	Renewable Energy Systems	20
10	Facility Energy Improvements	20

A sample Life Cycle Cost Analysis Summary Report is shown in Table 2.5.7.3 located on the following page. In this example, all the common

criteria noted in 2.5.7 Items A and B, was selected or entered into this summary report.

In Part 1 of the summary report, a construction cost of $10,000 and a design cost of $1,200 was assumed. The SIOH was calculated by the program.

In Part 2 of the summary report, an electric energy saving of 500 mmBtu/yr was assumed. A $500/yr demand savings shown in "2 M" was also assumed.

In Part 3 of the summary report, a maintenance savings of $100/yr was also assumed. In the actual summary report, the above-assumed numbers would originate from an ECO. In the example, the program calculated a simple payback of 2.77 years and a savings to investment ratio of 5.43.

Table 2.5.7.2

ECIP STUDY - LCCID READY REFERENCE

HELP or @ - To SH[illegible] how the question pertains to LCC and to [illegible] hints on allowable answers.
LIST or ? - To DISPLAY a LIST of allowable inputs.
TEACH - To begin seeing all the help messages before entering your response.
SAVE - To save the Study File from any prompt.
ABORT or QUIT - To TERMINATE the program without saving any information since the last SAVE or Auto-save.

MAIN MENU CHOI[illegible]
S = Select Study Param[illegible]
A = Define / Change Discrete Portions
C = Calculate & Report Life Cycle Costs
N = Select Next Study
D = Change Directory of Study/Report Files
<cr> = exit PROGRAM

S

SELECT STUDY PARAMETER Choices
C = Select Criteria for Present Worth Calculations
D = Select Key Study Dates
M = Select Dollar Input Multiplier
E = Select Energy Related Study Inputs
T = Select Study Identification Block
<cr> = exit SELECT STUDY PARAMETERS

D

SELECT KEY STUDY DATES Choices
L = Economic Life of Building
<cr> = exit SELECT KEY STUDY DATES

E

SELECT ENERGY RELATED STUDY INPUT Choices
S = Select Location (Region for E-Values)
U = Select Energy Input Units
P = Select Energy Prices
<cr> = exit SELECT ENERGY RELATED STUDY INPUT

P

SELECT ENERGY PRICES Choices
0 = Initialize All Energy Type Prices
1 = Select Prices of ELECT
2 = Select Prices of DIST
3 = Select Prices of RESID
4 = Select Prices of NAT G
5 = Select Prices of COAL
6 = Select Prices of LPG
7 = Select Prices of SOLAR
8 = Select Prices of GEOTH
9 = Select Prices of BIOMA
10 = Select Prices of REFUS
11 = Select Prices of WIND
12 = Select Prices of OTHER
<cr> exit SELECT ENERGY PRICES

T

SELECT STUDY IDENTIFICATION BLOCK Choices
I = Re-enter All Study Identification Block Data
T = Specify Project Title
L = Specify Installation Name
P = Specify Project Number
F = Specify Fiscal Year
A = Specify Name of Analyst
<cr> = exit SELECT STUDY IDENTIFICATION BLOCK

C

CALCULATE & REPORT LIFE CYCLE COSTS Choices
I = Generate ECIP Summary Reports
<cr> = exit CALCULATE & REPORT LIFE CYCLE COSTS

A

DEFINE / CHANGE DISCRETE PORTIONS Choices
L = List Discrete Portion Titles
S = Define / Change Discrete Portion Values
D = Delete Discrete Portions
R = Resequence Discrete Portion Identifiers
O = Put Discrete Portion Identifiers in Ascending Order
<cr> = exit DEFINE / CHANGE DISCRETE PORTIONS

S

DEFINE / CHANGE Discrete Portion Values
V = Specify Construction, SIOH, and Design Costs
E = Specify Energy Usage Savings
S = Specify Salvage Value of Existing Equipment
U = Specify Public Utility Rebate
M = Specify Annually Recurring Savings/Costs
R = Specify Non Recurring Savings/Costs
L = List this Discrete Portion's Identifier and Title
D = Delete this Discrete Portion
<cr> = exit DEFINE / CHANGE Discrete Portion Values

E

SELECT ENERGY PRICES Choices
0 = Initialize All Energy Type Prices
1 = Select Prices of ELECT
2 = Select Prices of DIST
3 = Select Prices of RESID
4 = Select Prices of NAT G
5 = Select Prices of COAL
6 = Select Prices of LPG
7 = Select Prices of SOLAR
8 = Select Prices of GEOTH
9 = Select Prices of BIOMA
10 = Select Prices of REFUS
11 = Select Prices of WIND
12 = Select Prices of OTHER
<cr> exit SELECT ENERGY PRICES

V

INVESTMENT COSTS Choices
I = Initialize All Investment Costs for this Discrete Portion
C = Specify Construction Cost and Related Information
D = Specify Design Cost and Related Information
O = Specify SIOH Cost and Related Information
<cr> = exit INVESTMENT COSTS

M

SPECIFY ANNUAL VALUES Choices
L = List Annual Values by Title
S = Define / Change Annual Values
D = Delete an Annual Value
<cr> = exit SPECIFY ANNUAL VALUES

R

SPECIFY ONE-TIME VALUES Choices
L = List One-time Values by Title
S = Define / Change One-time Values
D = Delete an One-time Value
<cr> = exit SPECIFY ONE-TIME VALUES

Table 2.5.7.3

Life Cycle Cost Analysis Study: LCCID FY96
Energy Conservation Investment Program (ECIP)
Installation & Location: Aberdeen Proving Grounds
Region data: MARYLAND Census Region: 3
Project NO. & Title: 4130.06 Sample ECO
Fiscal Year: 1995 Discrete Portion: Sample ECO
Analysis Date: 04/09/96 Economic Life: 20 years
Prepared by: SAB

ECIP Summary Report

1. Investment
   - A. Construction Cost 10000
   - B. SIOH 550
   - C. Design Cost 1200
   - D. Total Cost (1A+1B+1C) $11,750
   - E. Salvage Value of Existing Equip. $0
   - F. Public Utility Company Rebate $0
   - G. Total Investment (1D-1E-1F) $11,750

2. Energy Savings (+) / Costs (-)
Date of NISTIR 85-3273-X used for Discount Factors Oct 1994

Fuel	Price	Price Units	Usage Savings	Usage Units	Annual Savings	Discount Factor	Discounted Savings
Electricity	$7.3	/Mbtus	500	Mbtus	$3,635	15.08	$54,816
Elec. Deman					$500	14.88	$7,440
TOTAL			500	Mbtus	$4,135		$62,256

3. Non Energy Savings (+) / Costs (-)

Item	Savings/ Cost	Year	Discount Factor	Discounted Savings/Cost
New	$100	Annual	14.88	$1,488
ANNUAL TOTAL	$100			$1,488
ONE TIME TOTAL	$0			$0
TOTAL	$100			$1,488

4. First Year Dollar Savings $4,235
5. Simple Payback Period (Years) 2.77
6. Total Net Discounted Savings $63,744
7. Savings to Investment Ratio 5.43
   If < 1, Project does not qualify
8. Adjusted Internal Rate of Return 12.09%

2.6 Opinions of Cost

The Entech formatted opinion of construction cost represents the cost to the government of the construction project including the engineering. The estimate does not include the government's costs such as: supervision, overhead, change order reserves, and any costs associated with financing. This opinion is formed for current conditions and has not been escalated to account for inflation during the design and approval process.

2.6.1 Direct Costs

The itemized costs are considered the bare costs for material, labor, and temporary construction necessary to construct the project. Direct costs may have been determined by any of the following methods:

Published Cost Databases: Primary source of direct cost data is the MEANS Cost data books published in 1995 & 1996.

Manufacturers/Contractor Quotations: Certain pricing was obtained from Manufacturers/Contractors where it was considered more reliable than the published data.

Factors and Allowances: Where necessary, portions of the direct costs were factored as a percentage of the other work or established as an allowance.

2.6.2 Indirect Costs

Indirect costs are considered the mark ups to the material and labor involved in constructing the project. Indirect costs were itemized and applied in accordance with this outline and were be based upon the subtotal of the direct costs. The following indirect costs are included:

Fringes: These costs reflect the benefits portion of the Contractor's compensation to his workforce. Included herein are taxes, vacations, illnesses, and insurance.

Overhead and Profit: Contractor's overhead are the costs he faces to keep his business operating. The percent of those costs that are attributable to a particular project is a function of his size and workload. Therefore, it is only possible to represent this cost as a percentage of the preceding costs. Means considers a 12% mark up of direct costs as average. Profit, on the other hand, is related to risk and return on investment. Army Document TM 5-800-2, Chapter 12 has a formula for determining profit. In the absence of any of the project specific data, an 8% factor was considered reasonable for projects of this level of detail.

Design Contingency: Contingency Factors are applied to cover construction costs that can not be foreseen or itemized at the time of the estimate preparation. EM 1110-2-1301, 31 JUL 80, Appendix C, item a, column 2 is the source of the percentage employed in this study.

Supervision: This category includes the on-site management and support of the Contractors workforce.

Architecture/Engineering: This factor was applied to reflect the gross compensation to the Architect/Engineer. It may be broken down as follows: 2-3% for site investigation, 6% for design, 3-4% for title two services and 1-3% for reimbursables. Note that this cost is subtracted from the construction cost and itemized individually in the LCCID forecasts.

2.7 Draft Report/Client Review/Final Report

After the work has been substantially completed, Entech compiles the information into the report format. Entech then schedules a meeting with the client to present its findings. A copy of the report is supplied to the client for a more detailed review.

Following the review meeting, Entech incorporates the clients review comments, assembles ECOs into projects, as agreed upon, and produces a final report. Submission of this report completes the contracted effort.

3.0 FACILITY DESCRIPTION

3.1 General

Aberdeen Proving Grounds is located in Maryland thirty miles north of Baltimore on the Chesapeake Bay about fifteen miles south of the Pennsylvania boarder. The Base has two distinct campuses; Aberdeen & Edgewood, with Aberdeen being the focus of this study. The Post was opened in 1917 for Ordinance testing and education. The facility covers over 72,000 acres of land and includes 1,700 permanent buildings. There is a secure portion of the Base that comprises the majority of the land but also, a minority of the buildings . A partial map is shown in Figure 3.1.1 located at the end of this section.

3.2 Existing Electrical System

The Baltimore Gas and Electric Company (BG&E) furnishes power to Aberdeen through their Harford Substation. This substation is located immediately outside the *Maryland* gate on US Route 715. Power is purchased at the primary rate in the following configurations:

Meter A.......34.5 kV
Meter B.......34.5 kV
Meter C.......115 kV

All the power and distribution equipment following the meters is the owned by the government. The 115 kV line leaves the meter and is cabled overhead north to Aberdeen Boulevard and continuing east to Substation 18, outside Building 120. This service was originally extended to power a supersonic wind tunnel but, is idle today. The two 34.5 kV lines diverge following the meters and serve the remainder of the Base. These lines are also overhead and may be switched together at Substation 16. Further transformation and distribution occurs on

together at Substation 16. Further transformation and distribution occurs on Base in one of thirty-one (31) substations. Branching out from the main 34.5 kV lines are three different types of distribution systems; 13.2, 4160, and 2400 kV. These may be either overhead or underground. Entech has prepared Figures 3.2.1 and 3.2.2 to illustrate the general power distribution on the Post.

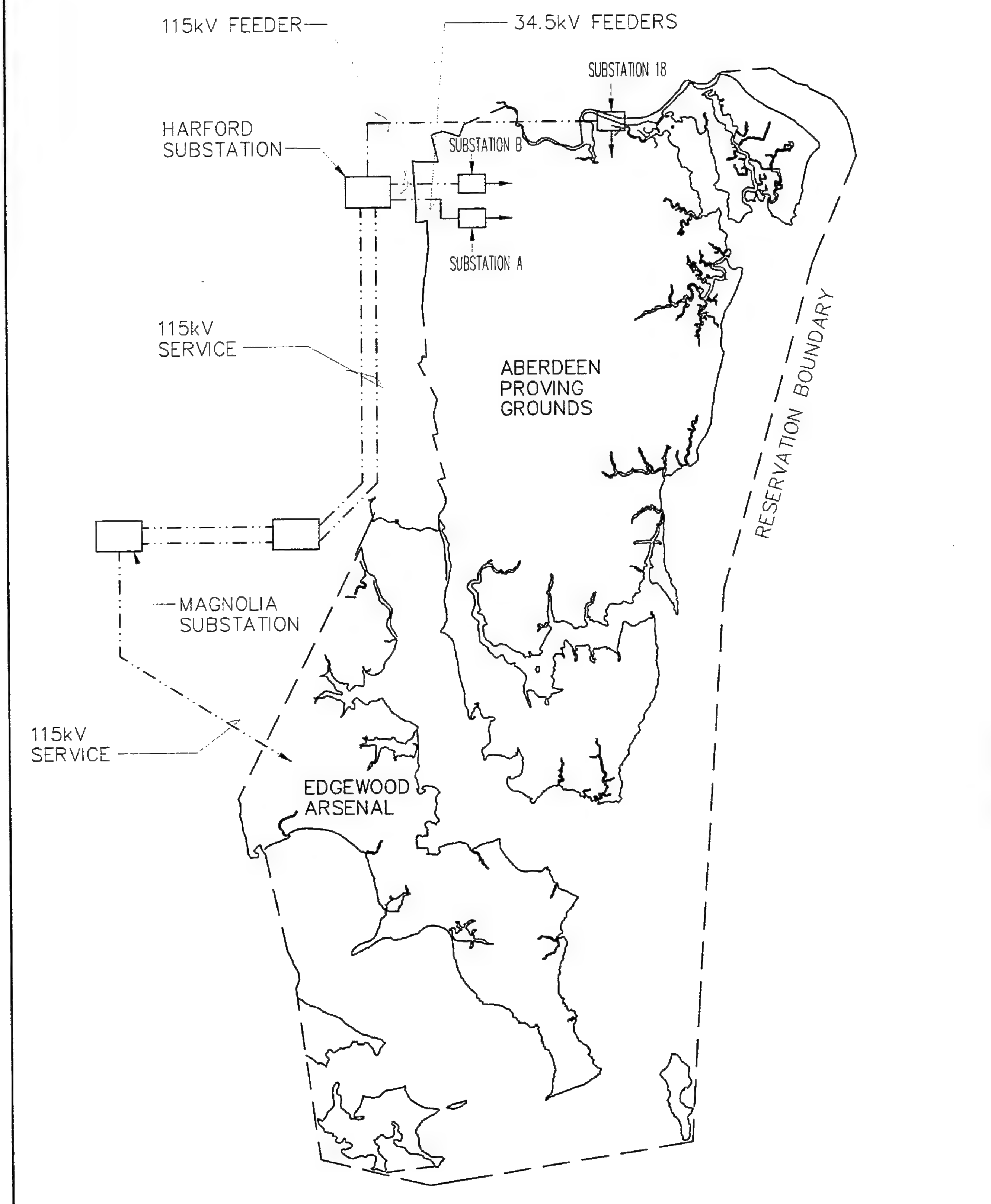
There are approximately forty (40) emergency generators scattered over the base with a combined capacity slightly over 5,000 kW.

3.3 Operation Schedule

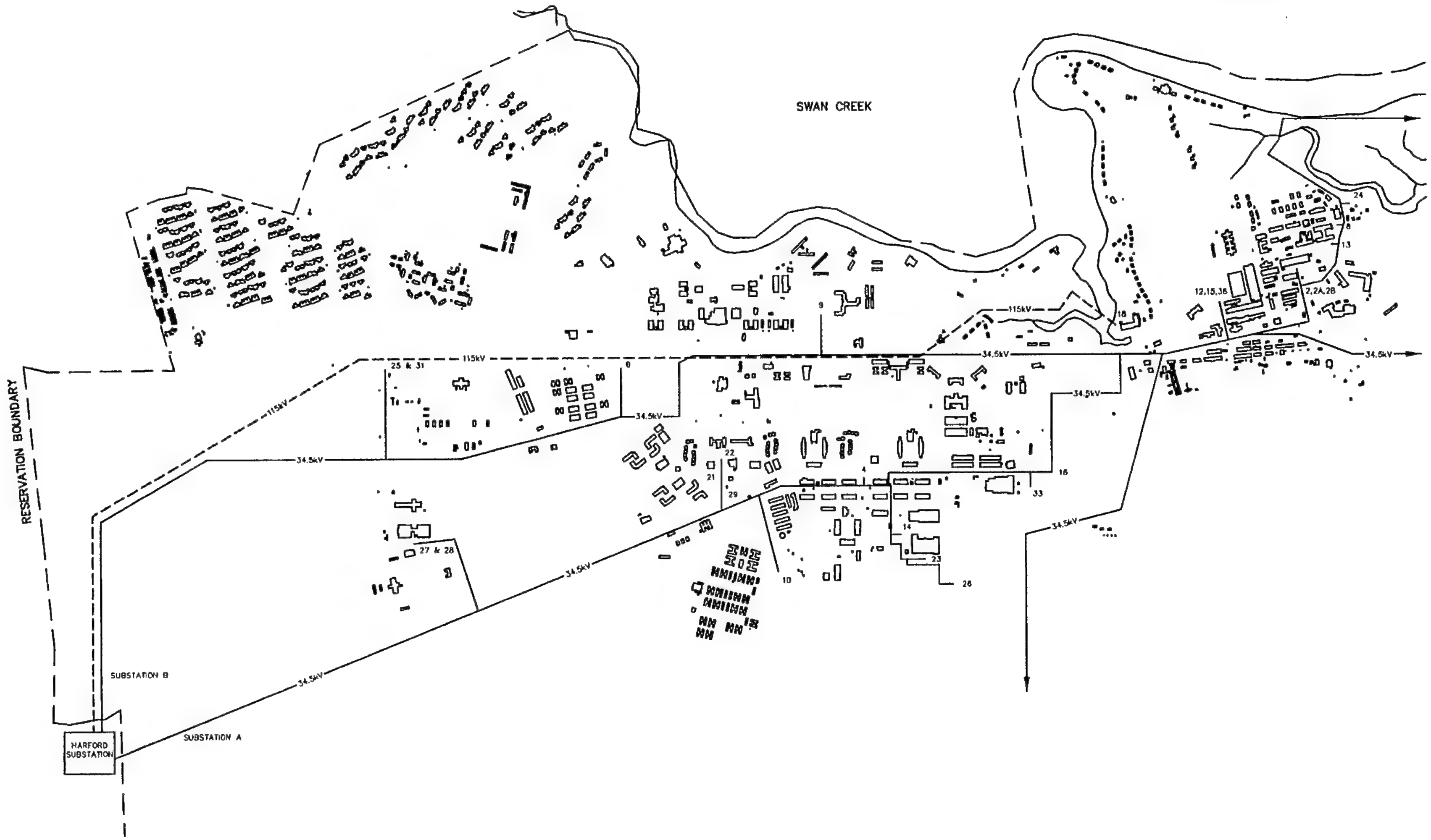
The Aberdeen facility is an open base with housing. Consequently, there is always a sizable electric load. The building operation hours are generally 7:00 AM to 6:00 PM with employees working nine (9) hours per day. The Post grants employees leave on alternating Fridays. Generally, the employee is permitted to establish a schedule of off-days, although certain command groups have made that determination for their personnel. The availability of a schedule selection with one week having more Fridays tangent to Monday holidays is reported to have unbalanced the Friday populations.

3.4 Condition of Equipment

Although not part of Entech's scope of work, our casual observations indicate the power distribution equipment was assembled over the years without much regard for standardization. Furthermore, the equipment itself seems to have been upgraded upon failure rather than on a preventative schedule.



ABERDEEN PROVING GROUNDS	ENTECH Engineering Inc. 4 SOUTH FOURTH STREET P.O. BOX 32 READING, PA 19603 (610) 373-6667 1851 WEST END AVE P.O. BOX 389 POTTSVILLE, PA 17901 (717) 628-5655				
ABERDEEN MARYLAND	DATE 1/24/96	DRAWN BY RJI	CHECKED BY JSP	PROJ. MGR. DEH	APPROVED
PLATE 3.1.1	SCALE NO SCALE	PROJECT NO. 4130.06		DRAWING NO.	REVISION 0



SUBSTATIONS NOT LOCATED ON THIS DRAWING: 1,3,5,7,11,19,20,30

LEGEND

115kV (dashed line)
34.5kV (solid line)

	CONSTRUCTION
	BIDDING PURPOSES
	CLIENT REVIEW
DATE	ISSUED FOR / APPD

ABERDEEN PROVING GROUNDS

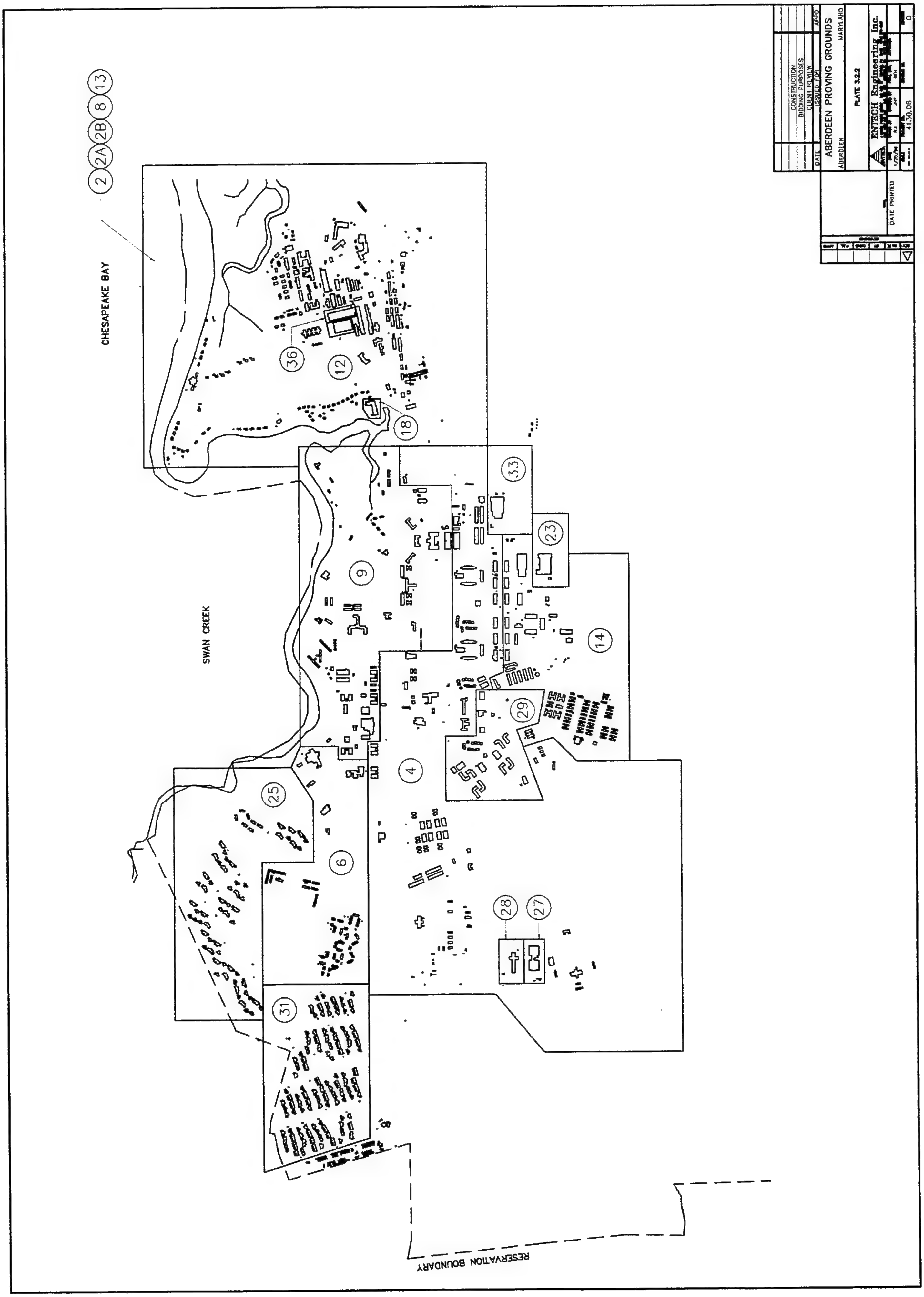
ABERDEEN MARYLAND

PLATE 3.2.2

ENTECH Engineering Inc.

DATE PRINTED

1/25/94 41.10.06 0


CHESAPEAKE BAY
SWAN CREEK
RESERVATION BOUNDARY
2
2A
2B
8
13
36
12
18
33
23
9
14
29
4
25
6
28
27
31
CONSTRUCTION
BIDDING PURPOSES
CLIENT REVIEW
ISSUED FOR
DATE
APPD
ABERDEEN PROVING GROUNDS
ABERDEEN
MARYLAND
PLATE 3.2.2
ENTECH Engineering Inc.
DATE PRINTED
1/25/94
RJ
JSP
DCH
4130.08
0

3.5 Metering Results

Twenty-eight (28) substations were metered as part of the work of this contract. The three (3) other known substations (6, 10, and 22) were out of service during the metering period. The metering was recorded by H&H Testing from October 17th through the 25th. H&H connected Dranetz 808 electric demand meters to the active feeders leaving the substations. The meters were calibrated to within a minute of each other and have a ±1% measurement accuracy. The meters generally recorded at least twenty-four (24) hours, except in cases where the testing agency and their government escort's schedules prohibited. Generally, the meters were placed on the feeders in a random order with the exception of service to residential areas where attempts were made to record on Friday's: anticipation of slightly higher loads due to the Post's operational schedules. The following information was collected.

1. Substation number and location
2. Incoming/outgoing voltages
3. Electrical demand readings on 30 minute intervals
4. Electric use during BG&E rating periods
5. Reactive demand
6. Ambient regional weather data
7. Date and time of readings

The above data was incorporated into a spreadsheet to be summarized so profiles could be drawn. The metering results can be found in Attachment 8.5. This data will be used in Section 5.0 to estimate the Post's energy consumption.

4.0 BILLING HISTORIES

4.1 General

The energy analysis for this report is based upon data during the 12-month period from October 1994 through September 1995. The total energy cost for the Post during that period was $9,800,000 and is distributed as follows:

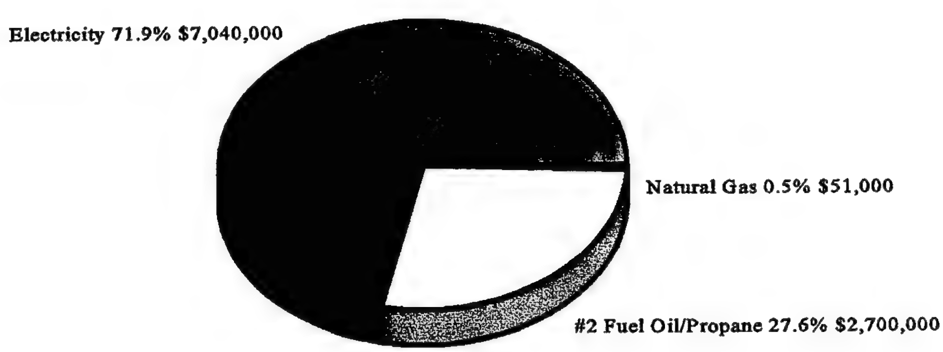
Table 4.1.1, Energy Cost Distribution

Electricity	$7,040,000
#2 Fuel Oil/Propane	$2,700,000
Natural Gas	$51,000
Total	$9,791,000
Use	$9,800,000

The annual energy cost distribution is graphically shown below in Figure 4.1.2.

Figure 4.1.2

Energy Cost Distribution



4.2 Electricity

Baltimore Gas and Electric Company (BG&E) provides power to the Post under the P rate (Primary Voltage Service). This rate is available to customers with electric demands of 1,500 kW/13,500 volts or higher. Table 4.2.1 below shows the rating periods as described in the rate schedule. A copy of the rate structure is located in Attachment 8.1. Table 4.2.2 on the following page displays the electric billing history for the Base during the past two years. Copies of actual electric bills can be found in Attachment 8.3.

Table 4.2.1, P Rate Schedule

Rating Periods	*Summer*	*Non-Summer*
On-Peak	10 AM - 8 PM	7 AM - 11 AM, 5 PM - 9 PM
Intermediate-Peak	7 AM - 10 AM, 8 PM - 11 PM	11 AM - 5 PM
Off-Peak	11 PM - 7 AM	9 PM - 7 AM

Table 4.2.2
Electric Billing History, 1993-94

Month	*Days*	*Distr. kW*	*Prod & Trans kW*	*Off-Peak kWh*	*Inter kWh*	*On-Peak kWh*	*Total kWh*	*Cost $*	*$/kWh*	*kWh/Day*	*mmBtu*
October, 1993	31	N/A	N/A	N/A	N/A	N/A	9,558,000	$455,564	$0.048	308,323	32,621
November	31	N/A	N/A	N/A	N/A	N/A	10,469,000	$491,974	$0.047	337,710	35,731
December	32	21,540	21,760	6,348,256	2,371,663	3,053,081	11,773,000	$540,945	$0.046	367,906	40,181
January, 1994	28	26,460	26,700	6,287,908	2,551,665	3,183,427	12,023,000	$591,459	$0.049	429,393	41,034
February	30	25,080	25,360	6,590,766	2,486,753	3,264,481	12,342,000	$588,822	$0.048	411,400	42,123
March	29	23,640	23,880	5,499,982	2,405,625	3,000,393	10,906,000	$535,734	$0.049	376,069	37,222
April	29	19,260	19,500	4,615,698	1,975,527	2,340,775	8,932,000	$437,153	$0.049	308,000	30,485
May	33	21,660	22,020	5,153,632	2,246,361	2,520,007	9,920,000	$472,371	$0.048	300,606	33,857
June	29	26,080	26,460	4,840,733	2,260,535	4,343,732	11,445,000	$833,256	$0.073	394,655	39,062
July	32	25,320	25,720	6,125,033	2,253,523	4,462,444	12,841,000	$865,229	$0.067	401,281	43,826
August	30	24,700	25,060	5,057,406	2,232,816	4,260,778	11,551,000	$813,874	$0.070	385,033	39,424
September	33	22,200	20,509	5,142,095	2,022,016	3,971,889	11,136,000	$744,525	$0.067	337,455	38,007
Total	367	235,940	236,969	55,661,509	22,806,484	34,401,007	132,896,000	$7,370,906	$0.055	362,114	453,574

Table 4.2.2 (Continued)
Electric Billing History, 1994-95

Month	*Days*	*Distr kW*	*Prod & Trans kW*	*Off-Peak kWh*	*Inter kWh*	*On-Peak kWh*	*Total kWh*	*Cost $*	*$/kWh*	*kWh/Day*	*mmBtu*
October, 1994	29	17,700	17,700	4,197,855	1,955,178	2,346,967	8,500,000	$398,763	$0.047	293,103	29,011
November	31	19,440	19,440	4,878,800	2,091,784	2,624,416	9,595,000	$404,198	$0.042	309,516	32,748
December	32	20,760	21,120	6,157,185	2,012,328	2,631,487	10,801,000	$492,221	$0.046	337,531	36,864
January, 1995	28	23,040	23,400	5,480,361	2,271,744	2,884,895	10,637,000	$512,067	$0.048	379,893	36,304
February	30	26,020	26,400	6,528,617	2,511,655	3,233,728	12,274,000	$583,819	$0.048	409,133	41,891
March	29	23,400	23,400	5,239,474	2,288,892	2,802,634	10,331,000	$503,751	$0.049	356,241	35,260
April	31	20,580	20,940	5,445,033	1,999,204	2,467,763	9,912,000	$466,577	$0.047	319,742	33,830
May	31	21,900	21,240	4,818,550	2,277,204	2,589,246	9,685,000	$467,793	$0.048	312,419	33,055
June	29	24,840	24,840	4,642,834	2,085,533	3,974,633	10,703,000	$767,897	$0.072	369,069	36,529
July	33	27,180	27,180	6,455,817	2,422,091	4,802,092	13,680,000	$844,156	$0.062	414,545	46,690
August	29	26,880	26,880	5,443,983	2,366,799	4,604,218	12,415,000	$852,442	$0.069	428,103	42,372
September	32	24,360	24,360	5,358,001	2,017,926	3,854,073	11,230,000	$749,579	$0.067	350,938	38,328
Total	364	276,100	276,900	64,646,510	26,300,338	38,816,152	129,763,000	$7,043,263	$0.054	356,492	442,881

4.2.1 Electric Submeter Readings

Aberdeen's electric service is currently metered at three locations. Submeter 20 monitors electric consumption at substation number 18, which is located next to Building 120. This substation supplies power specifically to the supersonic wind tunnel at 115 kV, and since May 1995 this meter has seen no activity. Submeters 22 and 23 adjoin BG&E's Harford Substation and provide general electric service to the Post at 34.5 kV. Table 4.2.1.1 below displays the submeter readings from October 1993 through September 1995. These submeter readings are used by BG&E to calculate the electric bill for the Post.

Table 4.2.1.1, Electric Submeter Readings

Month	*Days*	*Submeter 20*	*Submeter 22*	*Submeter 23*	*Total kWh*
October, 1993	31	N/A	N/A	N/A	9,558,000
November	31	N/A	N/A	N/A	10,469,000
December	32	166,000	3,361,000	8,246,000	11,773,000
January, 1994	28	142,000	7,419,000	4,462,000	12,023,000
February	30	167,000	7,641,000	4,534,000	12,342,000
March	29	146,000	6,756,000	4,004,000	10,906,000
April	29	148,000	5,432,000	3,352,000	8,932,000
May	33	175,000	5,998,000	3,747,000	9,920,000
June	29	180,000	6,218,000	5,047,000	11,445,000
July	32	211,000	5,794,000	6,836,000	12,841,000
August	30	140,000	5,403,000	6,008,000	11,551,000
September	33	164,000	5,355,000	5,617,000	11,136,000
Total	367	1,639,000	59,377,000	51,853,000	132,896,000

Table 4.2.1.1, Electric Submeter Readings (Continued)

Month	*Days*	*Submeter 20*	*Submeter 22*	*Submeter 23*	*Total kWh*
October, 1994	29	142,000	3,588,000	4,770,000	8,500,000
November	31	84,000	4,107,000	5,404,000	9,595,000
December	32	140,000	4,758,000	5,903,000	10,801,000
January, 1995	28	145,000	5,280,000	5,212,000	10,637,000
February	30	145,000	5,620,000	6,509,000	12,274,000
March	29	145,000	4,106,000	6,080,000	10,331,000
April	31	145,000	3,809,000	5,958,000	9,912,000
May	31	0	3,736,000	5,949,000	9,685,000
June	29	0	4,413,000	6,290,000	10,703,000
July	33	0	6,546,000	7,134,000	13,680,000
August	29	0	5,610,000	6,805,000	12,415,000
September	32	0	5,212,000	6,018,000	11,230,000
Total	364	946,000	56,785,000	72,032,000	129,763,000

4.2.2 Incremental Costs

Entech Engineering has developed a Lotus spreadsheet computer program to determine the incremental cost for electricity. Using actual billing data, usage and demand are entered into the program, and the cost is calculated. Entech's computer calculated cost matches the utility companys' bill.

To calculate the incremental cost for billing demand, the electric bill is re-calculated using one less kW of demand. The cost difference between the actual bill and the bill calculated with one less kW is considered to be the incremental cost for demand ($/kW).

The same procedure is performed for usage (kWh). The bill is calculated using one less kWh, with the difference in the two costs being the incremental usage cost ($/kWh). For this facility, the incremental cost for electricity is as follows:

Table 4.2.2.1, Incremental Costs

Incrementals	*Non-Summer (Oct-May)*	*Summer (Jun-Sept)*
Prod & Trans. Demand, $/kW	$5.99	$12.09
Distrib. Demand, $/kW	$2.33	$2.33
Total Demand, kW	$8.32	$14.42
Off-Peak, $/kWh	$0.025	$0.028
Interm., $/kWh	$0.034	$0.040
On-Peak, $/kWh	$0.036	$0.051
Average, $kWh	$0.030	$0.040

The incremental costs will be used in calculations of Energy Conservation Opportunities (ECO) as described in Section 2.

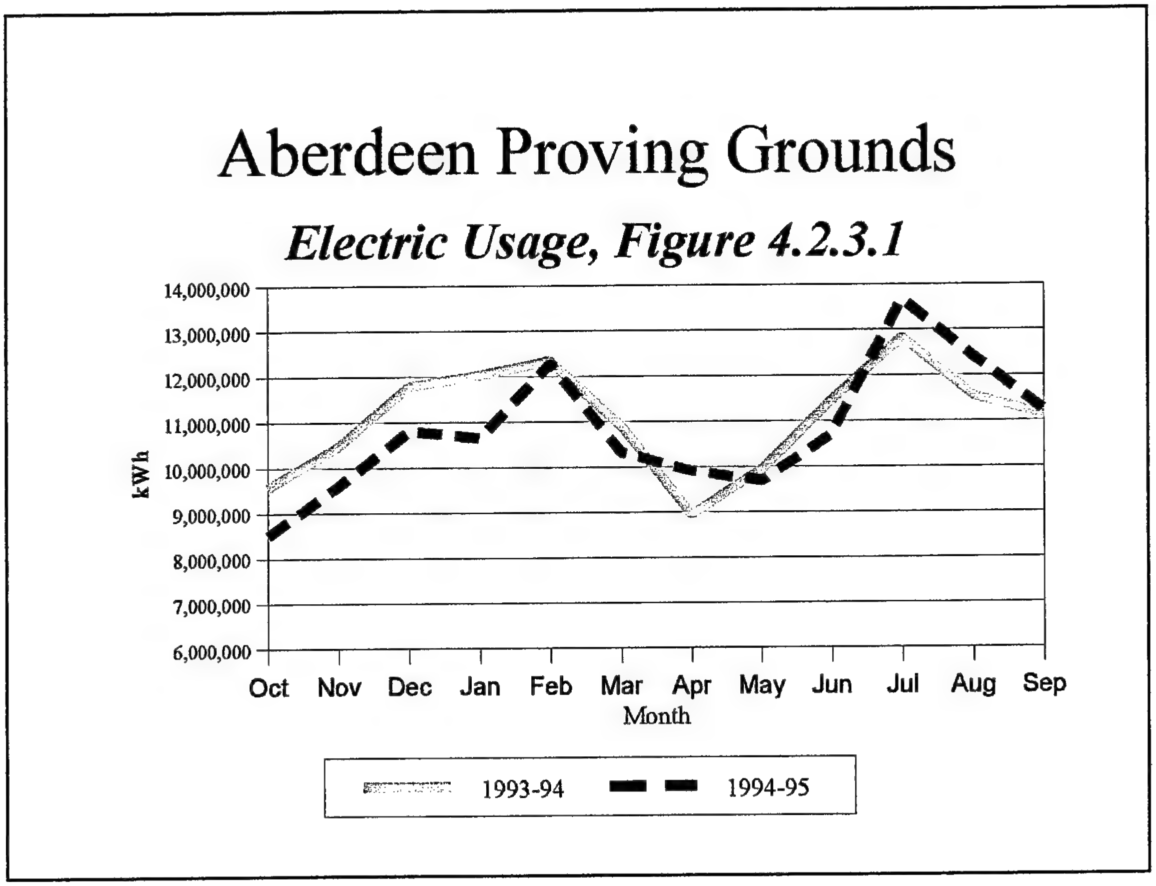
The use of incremental rates is reasonably accurate for calculating cost savings due to small changes in demand and usage (±10%) from existing levels. The use of incremental rates is less accurate in calculating cost savings with larger changes in demand and usage (>10%) and tends to underestimate savings slightly (usually < 2%). However, for the convenience of calculating the feasibility of various options, the use of incremental rates for demand and usage is either accurate or slightly conservative (savings not overestimated) and is therefore prudent.

Copies of the calculations of the incremental cost, and monthly electric bills are included in the Attachments 8.3 and 8.6.

4.2.3 Electric Usage

Electric usage is measured in kilowatt hours (kWh). One kWh is equivalent to the usage of 1,000 watts of electricity for one hour. Figure 4.2.3.1 on the following page graphically shows electrical usage profile of the Post for the period of October 1993 through September 1995.

The graph indicates that electric usage follows both a heating and cooling curve. The peaks during December, January, and February are due to the use of seasonal heating equipment, while the peaks during June, July, and August are due to air conditioning equipment.

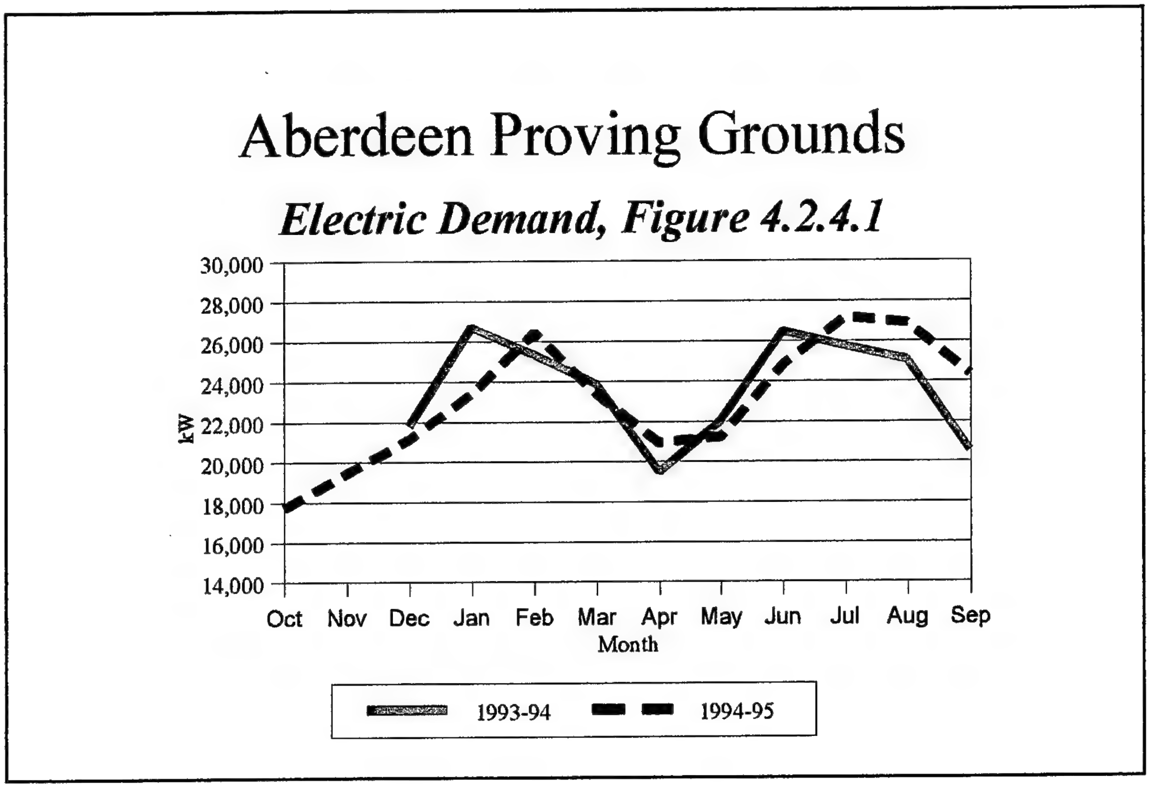


4.2.4 Monthly Demand

Electrical demand is the highest rate of electrical energy used during a specified time interval (normally 30 minutes). The measurement of electric demand is expressed as kilowatts (1,000 watts). Electrical demand is not necessarily related to the amount of time the electrical components are in operation. The monthly billing demand profile for the Post during the past year is graphically shown in Figure 4.2.4.1 on the following page.

From Figure 4.2.4.1, it can be seen that the on-peak demand rises during the winter months because of the heating equipment used on the Base. The summer months also show an increase due to the large amount of air

conditioning loads. These peaks will be discussed in greater detail in Section 5.



4.3 Fuel Oil

Fuel oil is presently used for heating various buildings and for emergency generators located on base. According to Base personnel, the fuel oil price per gallon during 1994-95 was $0.70. This rate is fixed for the entire year and will be used for energy savings calculations.

4.4 Natural Gas

The Post has a limited use of natural gas for space heating, cooking, domestic hot water during the course of a year. Installation of new service mains and corresponding projects to utilize additional natural gas are underway. Natural gas is provided by Baltimore Gas and Electric Company under Rate C (General Service Rate). Table 4.4.1 below displays natural gas consumption from October 1993 through September 1995. Copies of natural gas usage and costs are located in Attachment 8.7.

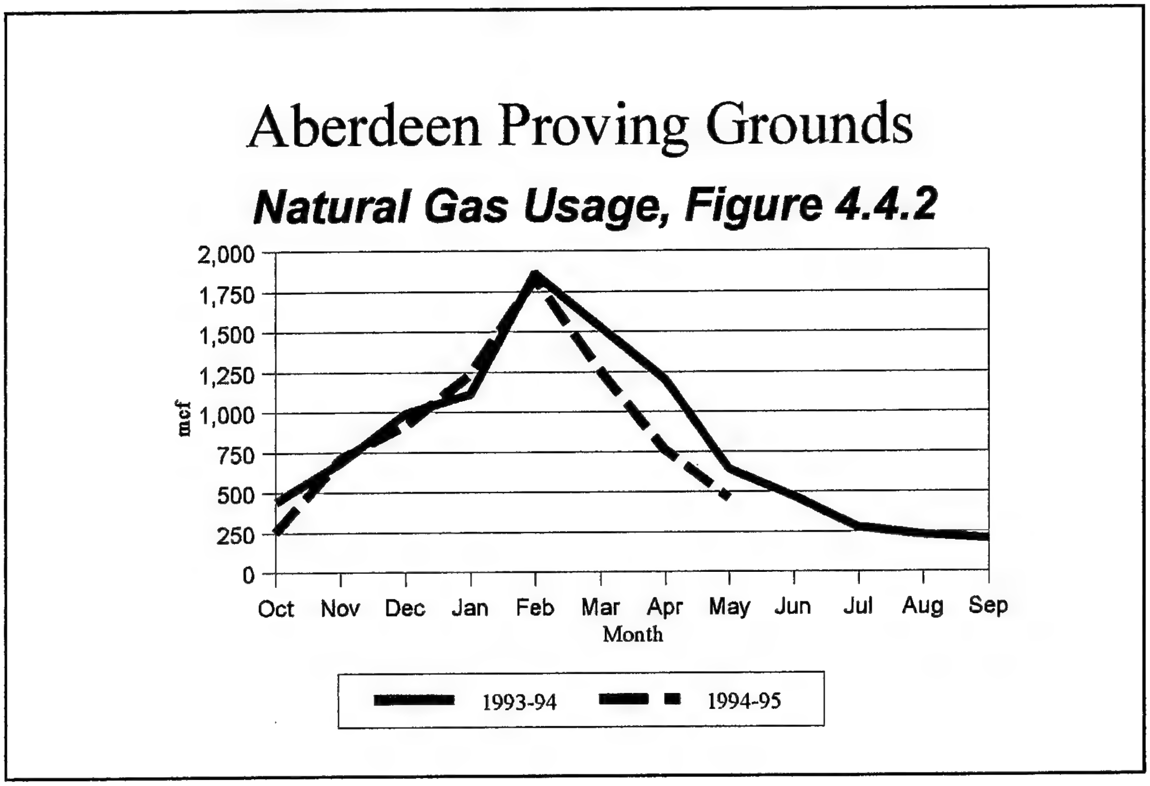
Table 4.4.1, Aberdeen Gas Usage

Month	*Usage(mcf)*	*Cost ($)*	*$ per mcf*	*mmBtu*
October, 1993	441	$2,264	$5.13	455
November	685	$3,558	$5.19	706
December	995	$5,142	$5.17	1,026
January, 1994	1,112	$5,816	$5.23	1,146
February	1,866	$9,775	$5.24	1,924
March	1,535	$8,337	$5.43	1,583
April	1,204	$6,775	$5.63	1,241
May	643	$3,675	$5.72	663
June	473	$2,180	$4.61	488
July	277	$1,301	$4.70	286
August	229	$1,047	$4.57	236
September	206	$970	$4.71	212
Totals	9,666	$50,840	$5.26	9,956

Table 4.4.1, Aberdeen Gas Usage (Continued)

Month	*Usage (mcf)*	*Cost ($)*	*$ per mcf*	*mmBtu*
October, 1994	253	$1,247	$4.93	261
November	710	$4,614	$6.50	732
December	919	$4,311	$4.69	947
January, 1995	1,238	$5,713	$4.61	1,276
February	1,833	$8,051	$4.39	1,890
March	1,260	$5,837	$4.63	1,299
April	762	$3,537	$4.64	786
May	461	$2,149	$4.66	475
June			$0.00	0
July			$0.00	0
August			$0.00	0
September			$0.00	0
Totals	7,436	$35,459	$4.77	7,659

Figure 4.4.2 on the following page graphically displays gas consumption for the past two years.


Aberdeen Proving Grounds
Natural Gas Usage, Figure 4.4.2
2,000
1,750
1,500
1,250
1,000
750
500
250
0
mcf
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
1993-94
1994-95

5.0 ELECTRIC DEMAND AND USAGE ANALYSIS

5.1 General

In order to identify practical demand reduction measures an analysis of existing electrical profiles must be performed. As part of this analysis, BG&E "Loadstar Billing Interface" data was compared to independent readings provided as part of this report. From this, general conclusions can be drawn about the following:

Peak day trends
Peak times
Base electrical load
Electric seasonal heating load
Electric seasonal cooling load
Electric model summary
Substations with highest demand

From the conclusions, Entech can concentrate on areas which have the potential of providing the most substantial demand savings.

5.2 BG&E "Loadstar Billing Interface Data"

Aberdeen provided four months of 15 minute interval demand readings. The four months provided were the following: June, August, September, and October 1995.

Copies of BG&E data can be found in Attachment 8.4. Analysis of the information follows:

5.2.1 Peak Day Trends

The table below indicates when the peak demand occurred for each month during the fiscal year. Data which was not obtained from "Loadstar Billing Interface Data" is extracted from actual electric bills. The table indicates that most of the peak days are either on a Wednesday or Thursday nine of the twelve months during 1993-94 and eight of the twelve months during 1994-95.

Table 5.2.1.1, Peak Day Trends

Month	*Day*	*kW*
October, 93	N/A	N/A
November	N/A	N/A
December	Wednesday	21,760
January, 94	Wednesday	26,700
February	Thursday	25,360
March	Monday	23,880
April	Thursday	19,500
May	Wednesday	22,020
June	Wednesday	26,460
July	Thursday	25,720
August	Thursday	25,060
September	Wednesday	20,509

Table 5.2.1.1, Peak Day Trends (Continued)

Month	*Day*	*kW*
October, 94	Thursday	17,700
November	Friday	19,440
December	Tuesday	21,120
January, 95	Thursday	23,400
February	N/A	26,400
March	N/A	23,400
April	Wednesday	20,940
May	Thursday	21,240
June	Wednesday	24,840
July	Wednesday	27,180
August	Wednesday	26,880
September	Thursday	24,360

From the observation during site surveys and discussion with base personnel the following conclusions were developed as shown below.

1. Base personnel work a schedule that includes alternative Fridays as off days.

2. Wednesday and Thursday peaks may be caused by an urgency to complete projects before staff departs for the weekend shutdown.

5.2.2 Peak Time Trends

The table below indicates what time the peak demand occurs. As with the previous section data was obtained from various sources.

Table 5.2.2.1, Peak Time Trends

Month	*Day*	*Time*	*kW*
October, 93	N/A	N/A	N/A
November	N/A	N/A	N/A
December	Wednesday	11:00 AM	21,760
January, 94	Wednesday	9:45 AM	26,700
February	Thursday	10:00 AM	25,360
March	Monday	9:00 AM	23,880
April	Thursday	11:00 AM	19,500
May	Wednesday	11:00 AM	22,020
June	Wednesday	1:30 PM	26,460
July	Thursday	1:30 PM	25,720
August	Thursday	1:45 PM	25,060
September	Wednesday	3:00 PM	20,509

Table 5.2.2.1, Peak Time Trends (Continued)

Month	*Day*	*Time*	*kW*
October, 94	Thursday	11:00 AM	17,700
November	Friday	8:15 AM	19,440
December	Tuesday	10:00 AM	21,120
January, 95	Thursday	8:30 AM	23,400
February	N/A	N/A	26,400
March	N/A	N/A	23,400
April	Wednesday	8:30 AM	20,940
May	Thursday	11:00 AM	21,240
June	Wednesday	2:45 PM	24,840
July	Wednesday	3:00 PM	27,180
August	Wednesday	2:15 PM	26,880
September	Thursday	1:45 PM	24,360

The above table indicates the following:

1. Peak demand during the winter months is always during the morning. Such a demand profile generally indicates electric heat and/or cooking equipment. Entech understands that there are a large number of residences utilizing electric heat pumps with electric resistance heat as back-up. This coupled with the large dining facilities is consistent with the typical consumption profile.

2. During the summer months, electric demand generally peaks in the afternoon. We expect this peak is due to the use of cooling equipment and perhaps some cooking equipment. Peak loads with cooling generally occur around 3:00 PM. The shift to an earlier peak may simply be the result of the Army starting work earlier than the national profile.

5.2.3 Base Electric Load

October data reflects consumption during a season with the least cooling operation and heating operations. During this period, HVAC systems were either at rest or seasonally unloaded. Using this data, Entech can formulate a reasonable estimation of a base electric load (lights, equipment, and non-seasonal HVAC systems).

Using "Loadstar Billing Interface Data" the highest demand recorded during October 13 through October 30 was 16,920 kW. The average usage during this period was calculated to be 290,800 kWh/day. These numbers will be used as the electrical base load. Table 5.2.3.1 on the following page represents these findings.

The base electric demand is 16,920 kW and the usage is 290,800 kWh/Day multiplied by the number of days during the month.

5.2.4 Electric Heating Load

Using BG&E data and the estimates for base electrical loads, Entech can estimate the annual heating energy of the base as shown on the previous page. The heating demand and usage is approximated by subtracting the base loads from the total electric demand and usage billed each month during the fiscal year.

Table 5.2.3.1, Base Electric Load Summary

Month	*Days*	*On-Peak kW*	*Total Usage kWh*	*Base Demand kW*	*Base Usage kWh*	*Heating Demand kW*	*Heating Usage kWh*	*Cooling Demand kW*	*Cooling Usage kWh*
October, 1994	29	17,700	8,500,000	16,920	8,433,200	0	0	780	66,800
November	31	19,440	9,595,000	16,920	9,014,800	2,520	580,200	0	0
December	32	21,120	10,801,000	16,920	9,305,600	4,200	1,495,400	0	0
January, 1995	28	23,400	10,637,000	16,920	8,142,400	6,480	2,494,600	0	0
February	30	26,400	12,274,000	16,920	8,724,000	9,480	3,550,000	0	0
March	29	23,400	10,331,000	16,920	8,433,200	6,480	1,897,800	0	0
April	31	20,940	9,912,000	16,920	9,014,800	4,020	897,200	0	0
May	31	21,240	9,685,000	16,920	9,014,800	0	0	4,320	670,200
June	29	24,840	10,703,000	16,920	8,433,200	0	0	7,920	2,269,800
July	33	27,180	13,680,000	16,920	9,596,400	0	0	10,260	4,083,600
August	29	26,880	12,415,000	16,920	8,433,200	0	0	9,960	3,981,800
September	32	24,360	11,230,000	16,920	9,305,600	0	0	7,440	1,924,400
Total	364	276,900	129,763,000	203,040	105,851,200	33,180	10,915,200	40,680	12,996,600

Note 1: The base electric load includes lighting and non-seasonal HVAC equipment.
Note 2: Also included in the base electrical load is any air conditioning equipment that operates during the entire year.

5.2.5 Electric Cooling Load

Using BG&E data an estimate for base cooling energy can be determined. The previous table illustrates this. The cooling energy can be approximated by subtracting the base demand and usage from the total billed demand and usage during the summer months.

5.3 Electrical Model

An electric model, has been developed for the entire Base and can be viewed in Table 5.3.1, on the following page. The model is employed to approximate the contribution from all electrical users to an annual electric cost. The electric model will be used during subsequent calculations to determine future energy costs and savings. Table 5.3.2 below summarizes the results of the electric model.

Table 5.3.2, Electric Model Summary

System	*kW*	*kWh*	*Cost, $*
Base Loads	203,040	105,851,200	$5,635,361
Seasonal Cooling	40,680	12,996,600	$1,067,990
Seasonal Heating	33,180	10,915,200	$603,514
Total	276,900	129,763,000	$7,306,865

Figure 5.3.3 on the following page graphically represents the distribution of electricity demand by system. This graph shows that base loads account for 73% of the total electric demand, while seasonal cooling loads account for 15% and seasonal heating loads 12% of the total electric demand.

Table 5.3.1, Electric Model
Aberdeen Proving Grounds

Description	Non-Summer Demand kW	Summer Demand kW	Non-Summer Usage kWh	Summer Usage kWh	Annual Totals Demand kW/yr	Annual Totals Usage kWh/yr	Annual Totals Cost $/yr
Base Equipment Loads	135,360	67,680	70,082,800	35,768,400	203,040	105,851,200	$5,635,361
Seasonal Cooling Loads	5,100	35,580	737,000	12,259,600	40,680	12,996,600	$1,067,990
Seasonal Heating Loads	33,180	0	10,915,200	0	33,180	10,915,200	$603,514
TOTALS	173,640	103,260	81,735,000	48,028,000	276,900	129,763,000	$7,300,000

Non-Summer

Total Incremental Demand Cost $/kW	$8.32
Average Incremental Usage Cost $/kWh	$0.030

Summer

Total Incremental Demand Cost $/kW	$14.42
Average Incremental Usage Cost $/kWh	$0.040

Non-Summer

October, November, December, January
February, March, April, May

Summer

June, July, August, September

Figure 5.3.3, Electric Model Results

Annual Demand Distribution

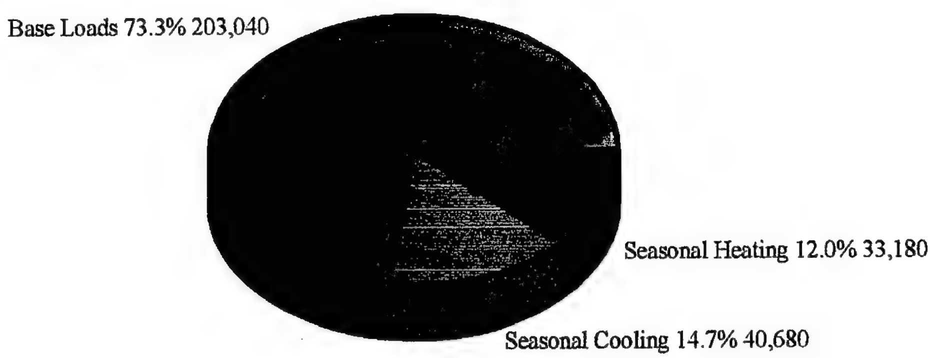


Figure 5.3.4, on the following page graphically shows the electric usage distribution by electrical system. The base load accounts for 82% of the total electric usage, seasonal cooling accounts for 10%, and seasonal heating accounts for 8%.

Figure 5.3.4, Electric Model Results

Annual Usage Distribution

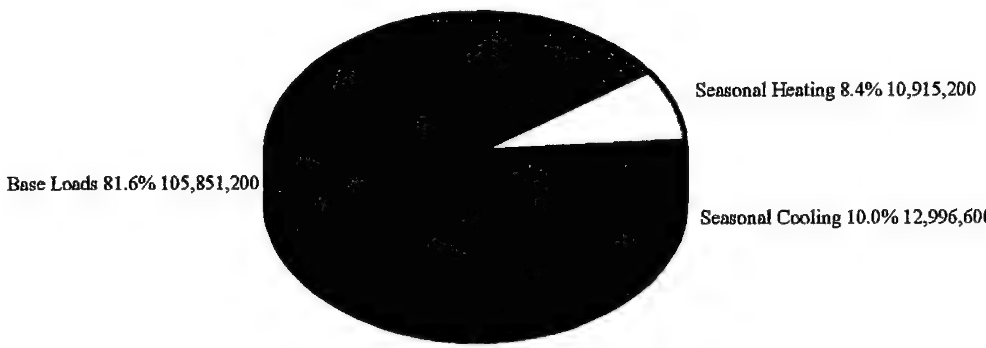
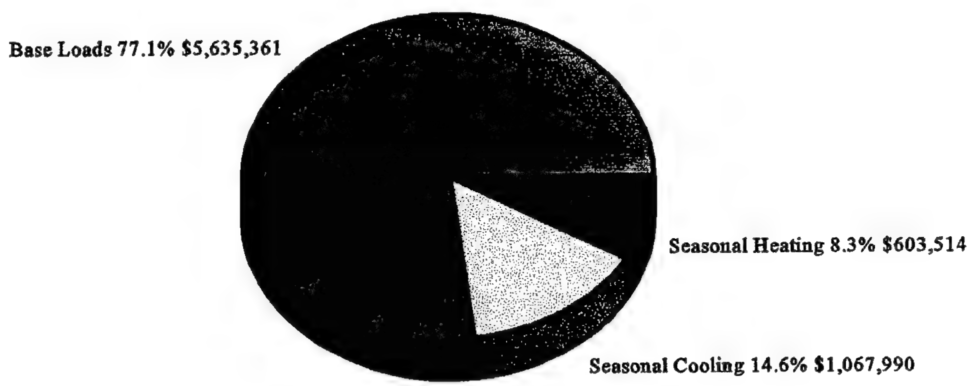


Figure 5.3.5, on the following page indicates the total electric cost by system for the entire Base. The base loads represent 77% of the total electric cost while, seasonal cooling accounts for 15% and seasonal heating for the remaining 8%.

Figure 5.3.5, Electric Model Results

Annual Cost Distribution



5.4 Substations with the highest demand

Using the metering data which is located in Attachment 8.5, the following graph can be drawn. Figure 5.4.1 on the following page illustrates which substations account for the largest amount demand.

Note: Substation 21 also includes substations 3, 24 ,26, and 28. Substation 31 also includes substation 5.

Aberdeen Proving Grounds

Figure 5.4.1, 1995 Electric Demand

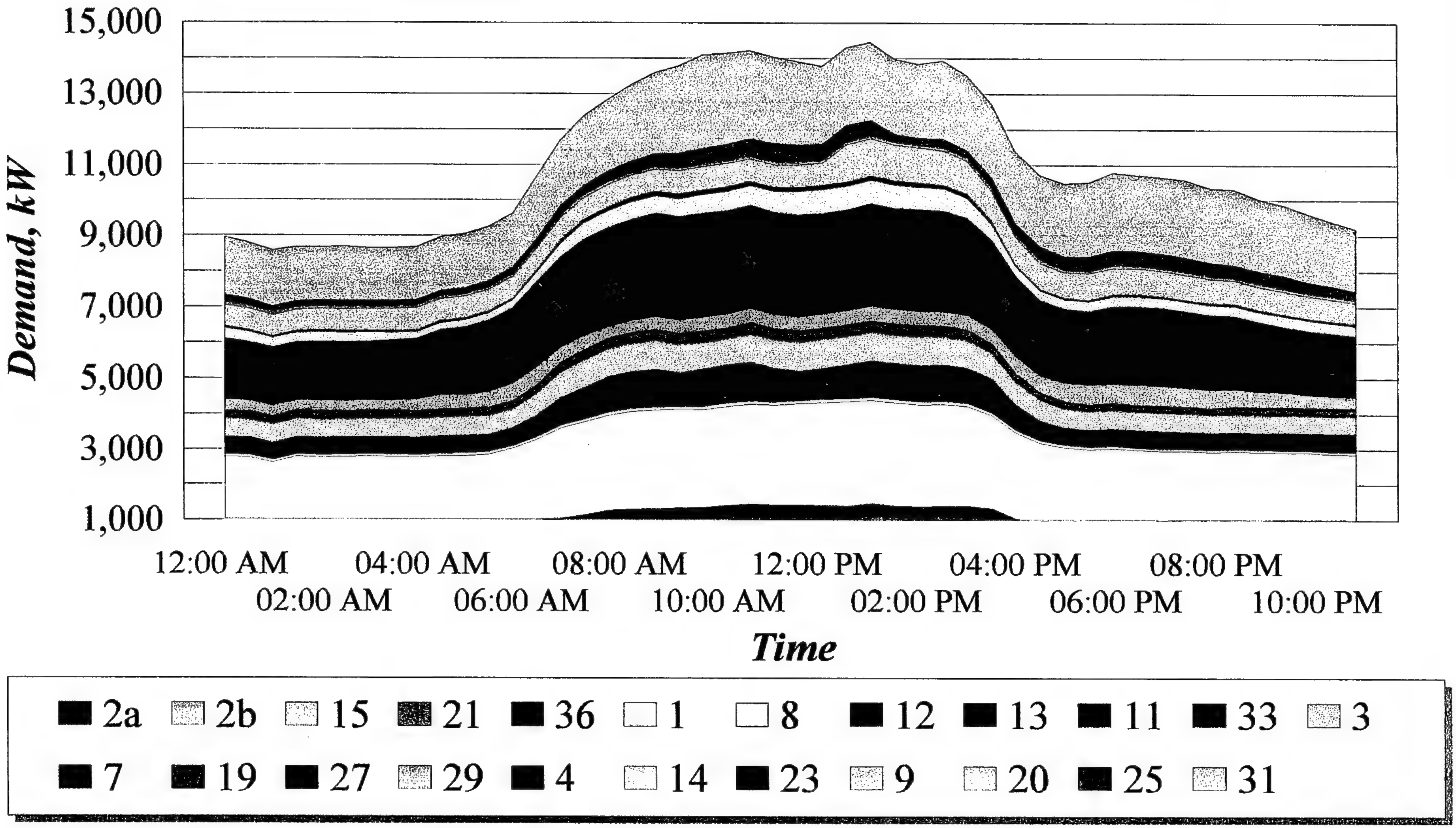
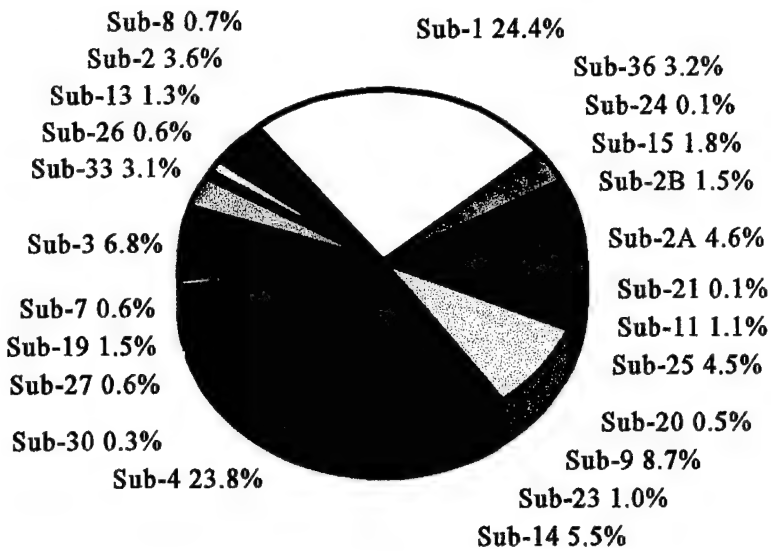


Figure 5.4.2, Substation Electric Demand

Percent Distribution



From the data Entech was able to conclude which substations account for more than 5% of the total electric demand on the Post. Table 5.4.3 on the following page displays the seven (7) substations which account for 78% of the total electric demand.

This table can suggest which substations and feeders on Base which needed to be examined in greater detail.

Table 5.4.3, Substations with highest demand

#	*Percent*	*Serves*
1	24.4%	Ordinance
4	23.8%	Town Center
9	8.7%	Town Center
3	6.8%	Weapons Test
14	5.5%	Barracks
2A	4.6%	Operations
25	4.5%	Housing
Total %	78.3%	

The analysis of the metering data presented above is based soley upon the field data collected during a non-synchronized 24 hour period. Abnormal usage, distribution anomolies, and unusual power routings, certainally corupts this data somewhat.

6.0 ENERGY CONSERVATION OPPORTUNITIES

6.1 General

The items discussed in this section of the report are the result of investigation of several energy cost reduction strategies and products. The items which appear to offer the most significant savings are presented herein and are called Energy Conservation Opportunities (ECOs). The format for an ECO addresses the following:

Existing discusses the current operational levels and approximate costs.

Proposed presents a new concept designed to save energy; however, it should be understood that the actual design has not yet been performed. Arrangements and quantities may change somewhat during final design.

Implementation Costs Estimate covers materials, labor, and indirect costs needed for a complete project, including associated engineering design and construction management costs. Escalation is not included. Costs are in 1996 dollars.

Savings shows an expected level of annual cost savings does not include price increases of various energy sources or interactive savings. The ECOs are calculated on a stand alone basis.

Discussion notes simple payback period, Savings to Investment Ratio (SIR), and additional monetary or operation factors involved in the ECO.

6.2 ECOs

The following ECOs have been evaluated for the Post. Later in Section 7.0 the ECOs will be separated as recommended and non-recommended. Recommended ECOs will have a payback period of under 10 years, while non-recommended will have payback periods over 10 years. These projects may still be attractive to the Post due to non-economical factors such as increase comfort or a reduction in maintenance requirements. Other projects, while not feasible at this time, should be considered when replacement of the existing equipment is required.

ECO #	*ECO Description*
1	New 115 kV Substation - Includes Two Transformers
1A	New 115 kV Substation - Includes One Transformer
2	Upgrading Substations 4 & 9 to 115 kV Through Substation 18
3	Upgrading Substation 18
4	Emergency Generation Rider
5	BG&E's Curtailment Service Rider
6	Peak Shaving with Emergency Generators
7	Electric Clothes Dryers to Natural Gas
8	Disable or Redirect Sensor for Doors at Building 3660
9	Limit use of Freezer Underfloor Warming System in Building 3660
10	Electric Clothes Dryers to Natural Gas - Includes New Dryers
11	Add Insulation to Exterior Freezer Wall in Building 3660
12	Building 314 Ice Storage System
13	Building 5046 Ice Storage System

ECO-1
New 115 kV Substation - Includes 2 Transformers

Existing. The Base currently has three feeders which provide power throughout the Base. Two of the feeders are metered at 34.5 kV and feed the government owned Substations A and B. The third feeder is metered at 115 kV and feeds Building 120. Electric bills indicate that this third feeder has been out-of-service since May 1995. Substations A & B are fed from the BG&E owned Harford Substation. The total annual base electric production and transmission demand is 276,900 kW and usage is 129,763,000 kWh. In addition the Base is charged for 276,100 kW of yearly distribution demand (see billing history totals on page 4-4).

The rate structure states any service metered at less than 115 kV is subject to a distribution demand charge. This charge is based on the maximum kW of demand recorded during any of the rating periods for each month. The cost of distribution demand is \$2.33/kW. The annual distribution demand cost for the Base during 1994-95 was \$640,000.

Distribution Electric Demand	=	276,100 kW/yr (Section 4)
Dist. Electric Cost	=	\$640,000 (276,100 kW/yr x 2.33/kW = \$643,313, use \$640,000).

Proposed. Construct a new 115 kV substation with two (2) transformers on Base property to provide power for the entire base. The new substation will receive power from BG&E at 115 kV and transform the power to 34.5 kV for further distribution on the existing power network.

Because the power is received at 115 kV it is not subject to distribution demand charges under BG&E's Schedule P rate. Therefore this charge drops to zero (\$0).

The new substation will experience conversion losses in the new transformers of approximately 1%. Thus, electric usage will rise about 1,297,630 kWh/yr and usage costs will rise about $39,000/yr.

Electric Usage	=	1,297,630 kWh/yr (129,763,000 kWh/yr x 1%)
Electric Usage Cost	=	$39,000 (1,297,630 kWh/yr x $0.030/kWh = $38,929 use $39,000

The new substation will require additional maintenance by the base personnel (or a subcontractor). See discussion section for cost impact.

The purposed one-line diagram for this ECO is enclosed on page 6-7. The substation will include all equipment and structures to make it fully operational including disconnects, circuit breakers, protective equipment, transformers, metering etc. This substation would then feed existing substations A and B which are owned and operated by the Base.

Implementation Cost Estimate. The estimated construction costs of a new dual transformer substation for the base is $4,100,000. (Reference the attached cost estimate)

Material	$ 2,800,000
Labor	$ 760,000
Engineering	$ 540,000

Savings. The yearly energy cost savings resulting from implementation of this ECO are project is estimated to be $600,000 ($640,000-$39,000 = $601,000, use $600,000). This amount is based on the actual BG&E distribution demand charges for Aberdeen fiscal year 1995.

Electric Usage	=	-1,297,630 kWh/yr (129,763,000 kWh/yr - 131,106,630 kWh/yr)
Energy Usage	=	-4,429 mmBtu/yr (1,297,630 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

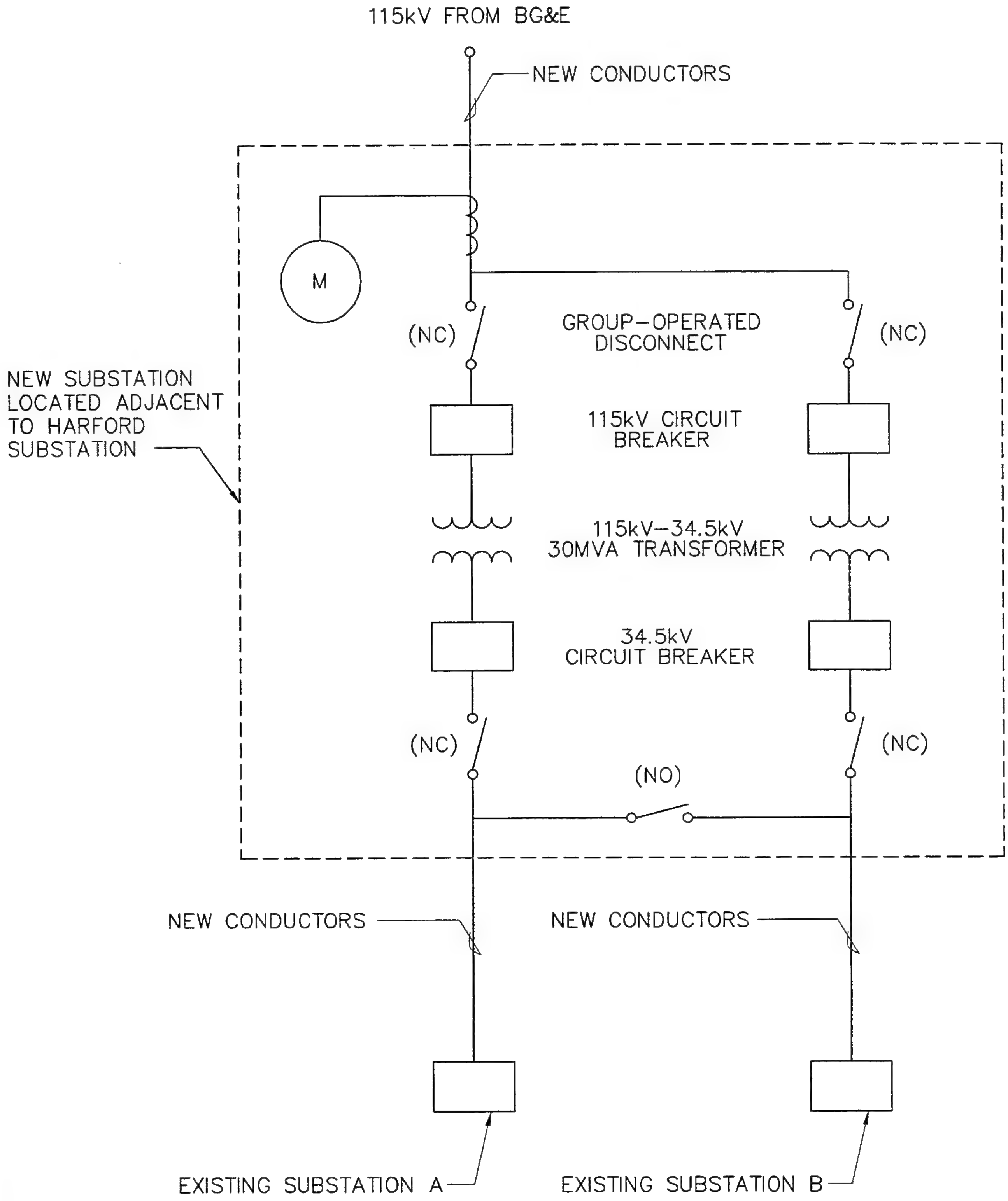
Discussion. The simple payback period for this ECO is 6.8 years (\$4,100,000÷\$600,000). A preventive maintenance program will need to be established for the new substation which is not included in this evaluation. It is estimated that a yearly cost of \$15,000 will be required to facilitate the required preventive maintenance on the substation. This would increase the payback to 7.0 years (\$4,100,000÷\$585,000). The Savings to Investment Ratio (SIR) is 1.9. The LCCID calculation are located in Attachment 8.9.

Reliability will be the same as currently supplied by BG&E.

The substation outlined in this ECO provides a high level of reliability by providing redundant transformers, protective devices, and disconnects. In the event of a failure of either of the transformers, switching can occur to permit the entire base to be fed from the other transformer.

CONSTRUCTION COST ESTIMATE	DATE PREPARED 11-Apr-96	SHEET 1 OF 1
PROJECT: Aberdeen Proving Grounds - ECO 1	BASIS FOR ESTIMATE	
LOCATION: Aberdeen, MD	[X] CODE A (NO DESIGN COMPLETED) [ ] CODE B (PRELIMINARY DESIGN) [ ] CODE C (FINAL DESIGN) [ ] OTHER (SPECIFY)________	
ARCHITECT ENGINEER: ENTECH ENGINEERING, INC.		
DRAWING NO.: G:\PROJECTS\4130.06\SS\ECOCOSTS.WK	ESTIMATOR: JSP	CHECKED BY

ELECTRICAL SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
DEMOLITION							
Substations A and B Feeders	1	LOT		$0	$20,000.00	$20,000	$20,000
PRIMARY FEEDER							
Poles	5	EA	$1,800.00	$9,000	$2,800.00	$14,000	$23,000
Conductors	1	MILE	$7,500.00	$4,500	$1,900.00	$1,140	$5,640
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
SUBSTATION							
30 MVA, 115kV-34.5kV Xfmr	2	EA	$296,250.00	$592,500	$19,050.00	$38,100	$630,600
115kV Circuit Breaker	2	EA	$147,500.00	$295,000	$12,800.00	$25,600	$320,600
34.5kV Circuit Breaker	2	EA	$41,500.00	$83,000	$2,725.00	$5,450	$88,450
115kV Disconnect Switch	2	EA	$23,100.00	$46,200	$4,025.00	$8,050	$54,250
Lightning Arrestors	12	EA	$3,775.00	$45,300	$366.00	$4,392	$49,692
Site Grading	5000	SY	$2.00	$10,000	$6.00	$30,000	$40,000
Site Grounding	1	LOT	$25,000.00	$25,000	$30,000.00	$30,000	$55,000
Structural Steel	1	LOT	$160,000.00	$160,000	$80,000.00	$80,000	$240,000
Fencing	1400	LF	$5.55	$7,770	$4.14	$5,796	$13,566
Equipment Pads	1	LOT	$35,000.00	$35,000	$20,000.00	$20,000	$55,000
Protective Relaying Enclosure	1	EA	$10,000	$10,000	$2,000.00	$2,000	$12,000
Protective Relaying	1	LOT	$24,000.00	$24,000	$14,000.00	$14,000	$38,000
Station Service Transformer	1	EA	$49,000.00	$49,000	$366.00	$366	$49,366
Battery Charger/Batteries	2	EA	$2,500.00	$5,000	$450.00	$900	$5,900
Metering C.T.'s	1.0	LOT	15400.00	$15,400	$1,095.00	$1,095	$16,495
Metering P.T.'s	1	LOT	10500.00	$10,500	$913.00	$913	$11,413
Busswork	600	LF	$485.00	$291,000	$45.50	$27,300	$318,300
Stone Backfill	5000	SY	$1.10	$5,500	$1.60	$8,000	$13,500
Group-Operated Disconnect	3.00	EA	$11,400.00	$34,200	$1,900.00	$5,700	$39,900
SECONDARY FEEDERS							
Substation A							
Poles(incl. crossarms & insulators)	5	EA	$1,400.00	$7,000	$2,300.00	$11,500	$18,500
Conductors	1	MILE	$5,100.00	$4,590	$1,880.00	$1,692	$6,282
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
Substation B							
Poles(incl. crossarms & insulators)	6	EA	$1,400.00	$8,400	$2,300.00	$13,800	$22,200
Conductors	1	MILE	$5,100.00	$6,120	$1,880.00	$2,256	$8,376
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
SUBTOTAL				$1,797,210		$376,604	$2,173,814
FRINGES @ 28%						$105,449	$105,449
OVERHEAD & PROFIT @ 20%				$359,442		$96,411	$455,853
DESIGN CONTINGENCY @ 25%				$539,163		$144,616	$683,779
SUPERVISION @ 5%				$134,791		$36,154	$170,945
ENGINEERING @ 15%							$540,000
TOTAL THIS SHEET				$2,800,000		$760,000	$4,100,000



ABERDEEN PROVING GROUNDS ABERDEEN MARYLAND	ENTECH Engineering Inc. 4 SOUTH FOURTH STREET P.O. BOX 32 READING, PA 19603 (610) 373-6667 1851 WEST END AVE P.O. BOX 389 POTTSVILLE, PA 17901 (717) 628-5655					
MAIN TRANSFORMER OWNERSHIP ECO-1	DATE 1/5/96	DRAWN BY RJI	CHECKED BY JSP	PROJ. MGR. DEH	APPROVED	
	SCALE NO SCALE	PROJECT NO. 4130.06		DRAWING NO. ECO-1		REVISION 0

ECO-1A
New 115 kV Substation - Includes 1 Transformer

Existing. The Base currently has three feeders which provide power throughout the Base. Two of the feeders are metered at 34.5 kV and feed the government owned Substations A and B. The third feeder is metered at 115 kV and feeds Building 120. Electric bills indicate that this third feeder has been out-of-service since May 1995. Substations A & B are fed from the BG&E owned Harford Substation. The total annual base electric production and transmission demand is 276,900 kW and usage is 129,763,000 kWh. In addition the Base is charged for 276,100 kW of yearly distribution demand (see billing history totals on page 4-4).

The rate structure states any service metered at less than 115 kV is subject to a distribution demand charge. This charge is based on the maximum kW of demand recorded during any of the rating periods for each month. The cost of distribution demand is \$2.33/kW. The annual distribution demand cost for the base during 1994-95 was \$640,000.

Distribution Electric Demand	=	276,100 kW/yr (Section 4)
Dist. Electric Cost	=	\$640,000 (276,100 kW/yr x 2.33/kW = \$643,313, use \$640,000).

Proposed. Construct a new 115 kV substation with one (1) transformer on Base property to provide power for the entire Base. The new substation will receive power from BG&E at 115 kV and transform the power to 34.5 kV for further distribution on the existing power network.

Because the power is received at 115 kV it is not subject to distribution demand charges under BG&E's Schedule P rate. Therefore this charge drops to zero (\$0).

The new substation will experience conversion losses in the new transformer of approximately 1%. Thus, electric usage will rise about 1,297,630 kWh/yr and usage costs will rise about $39,000/yr.

Electric Usage	=	1,297,630 kWh/yr (129,763,000 kWh/yr x 1%)
Electric Usage Cost	=	$39,000 (1,297,630 kWh/yr x $0.030/kWh = $38,929 use $39,000

The new substation will require additional maintenance by the base personnel (or a subcontractor). See discussion section for cost impact.

The purposed one-line diagram for this ECO is enclosed on page 6-7. The substation will include all equipment and structures to make it fully operational including disconnects, circuit breakers, protective equipment, transformer, metering etc. This substation would then feed existing substations A and B which are owned and operated by the base.

Implementation Cost Estimate. The estimated construction costs of a new single transformer substation for the base is $2,650,000, use $2,700,000. (Reference the attached cost estimate)

Material	$ 1,800,000
Labor	$ 500,000
Engineering	$ 350,000

Savings. The yearly energy cost savings resulting from implementation of this ECO are project is estimated to be $600,000 ($640,000-$39,000 = $601,000, use $600,000). This amount is based on the actual BG&E distribution demand charges for Aberdeen fiscal year 1995.

Electric Usage	=	-1,297,630 kWh/yr (129,763,000 kWh/yr - 131,106,630 kWh/yr)
Energy Usage	=	-4,429 mmBtu (1,297,630 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

Discussion. The simple payback period for this ECO is 4.5 years ($2,700,000÷$600,000). A preventive maintenance program will need to be established for the new substation which is not included in this evaluation. It is estimated that a yearly cost of $15,000 will be required to facilitate the required preventive maintenance on the substation. This would increase the payback to 4.6 years ($2,700,000÷$585,000). The Savings to Investment Ratio (SIR) is 2.9. The LCCID calculation are located in Attachment 8.9.

Reliability will be the same as currently supplied by BG&E.

There is no reliability associated with this ECO, since it is a single transformer substation. In the event of a failure of the transformer, a portable transformer would have to installed to permit the entire base to be fed until the existing transformer is repaired.

CONSTRUCTION COST ESTIMATE

DATE PREPARED 11-Apr-96

SHEET 1 OF 1

PROJECT: Aberdeen Proving Grounds - ECO 1A

LOCATION: Aberdeen, MD

ARCHITECT ENGINEER: ENTECH ENGINEERING, INC.

DRAWING NO.: G:\PROJECTS\4130.06\SS\ECOCOSTS.WK

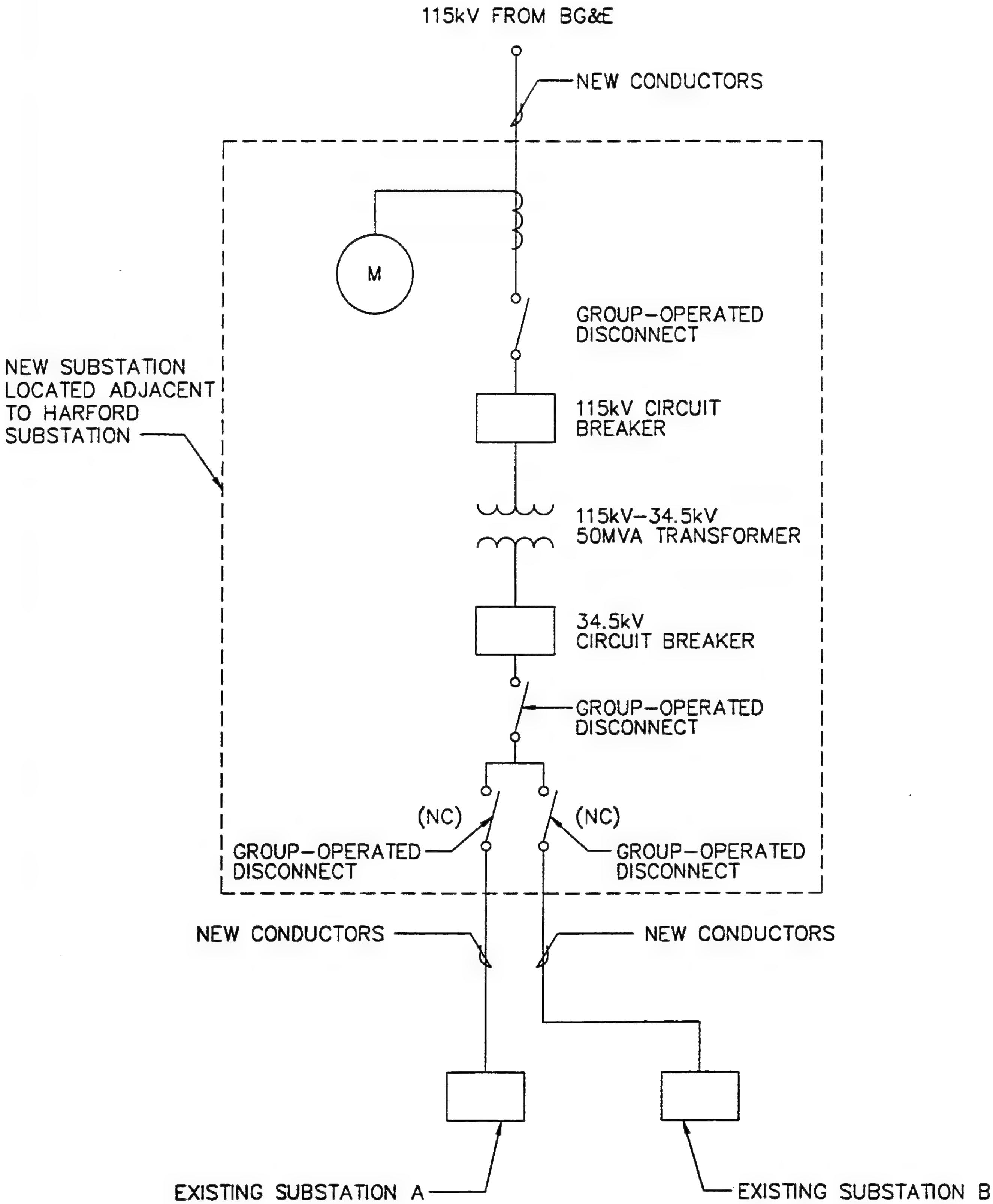
ESTIMATOR: JSP

CHECKED BY:

BASIS FOR ESTIMATE

[X] CODE A (NO DESIGN COMPLETED)
[ ] CODE B (PRELIMINARY DESIGN)
[ ] CODE C (FINAL DESIGN)
[ ] OTHER (SPECIFY)______

ELECTRICAL SUMMARY	QUANTITY		MATERIAL		LABOR		TOTAL
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	COST
DEMOLITION							
Substations A and B Feeders	1	LOT		$0	$20,000.00	$20,000	$20,000
PRIMARY FEEDER							
Poles	5	EA	$1,800.00	$9,000	$2,800.00	$14,000	$23,000
Conductors	1	MILE	$7,500.00	$4,500	$1,900.00	$1,140	$5,640
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
SUBSTATION							
50 MVA, 115kV-34.5kV Xfmr	1	EA	$457,500.00	$457,500	$31,100.00	$31,100	$488,600
115kV Oil Circuit Breaker	1	EA	$147,500.00	$147,500	$12,800.00	$12,800	$160,300
34.5kV Oil Circuit Breaker	1	EA	$41,500.00	$41,500	$2,725.00	$2,725	$44,225
115kV Disconnect Switch	1	EA	$23,100.00	$23,100	$4,025.00	$4,025	$27,125
Lightning Arrestors	6	EA	$3,775.00	$22,650	$366.00	$2,196	$24,846
Site Grading	2500	SY	$2.00	$5,000	$6.00	$15,000	$20,000
Site Grounding	1	LOT	$15,000.00	$15,000	$20,000.00	$20,000	$35,000
Structural Steel	1	LOT	$80,000.00	$80,000	$40,000.00	$40,000	$120,000
Fencing	700	LF	$5.55	$3,885	$4.14	$2,898	$6,783
Equipment Pads	1	LOT	$25,000.00	$25,000	$15,000.00	$15,000	$40,000
Protective Relaying Enclosure	1	EA	$8,000.00	$8,000	$1,200.00	$1,200	$9,200
Protective Relaying	1	LOT	$12,000.00	$12,000	$7,000.00	$7,000	$19,000
Station Service Transformer	1	EA	$49,000.00	$49,000	$366.00	$366	$49,366
Battery Charger/Batteries	1	EA	$2,500.00	$2,500	$450.00	$450	$2,950
Metering C.T.'s	1.0	LOT	$15,400.00	$15,400	$1,095.00	$1,095	$16,495
Metering P.T.'s	1	LOT	$10,500.00	$10,500	$913.00	$913	$11,413
Busswork	300	LF	$485.00	$145,500	$45.50	$13,650	$159,150
Stone Backfill	2500	SY	$1.10	$2,750	$1.60	$4,000	$6,750
Group-Operated Disconnect	3.00	EA	$11,400.00	$34,200	$1,900.00	$5,700	$39,900
SECONDARY FEEDERS							
Substation A							
Poles(incl. crossarms & insulators)	5	EA	$1,400.00	$7,000	$2,300.00	$11,500	$18,500
Conductors	1	MILE	$5,100.00	$4,590	$1,880.00	$1,692	$6,282
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
Substation B							
Poles(incl. crossarms & insulators)	6	EA	$1,400.00	$8,400	$2,300.00	$13,800	$22,200
Conductors	1	MILE	$5,100.00	$6,120	$1,880.00	$2,256	$8,376
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
SUBTOTAL				$1,153,825		$249,060	$1,402,885
FRINGES @ 28%						$69,737	$69,737
OVERHEAD & PROFIT @ 20%				$230,765		$63,759	$294,524
DESIGN CONTINGENCY @ 25%				$346,148		$95,639	$441,787
SUPERVISION @ 5%				$86,537		$23,910	$110,447
ENGINEERING @ 15%							$350,000
TOTAL THIS SHEET				$1,800,000		$500,000	$2,700,000



ABERDEEN PROVING GROUNDS

ABERDEEN MARYLAND

MAIN TRANSFORMER OWNERSHIP
ECO–1A

ENTECH Engineering Inc.
4 SOUTH FOURTH STREET P.O. BOX 32 READING, PA 19603 (610) 373-6667
1851 WEST END AVE P.O. BOX 389 POTTSVILLE, PA 17901 (717) 628-5655

DATE	DRAWN BY	CHECKED BY	PROJ. MGR.	APPROVED
1/5/96	RJI	JSP	DEH	

SCALE	PROJECT NO.	DRAWING NO.	REVISION
NO SCALE	4130.06	ECO–1A	0

ECO-2
Upgrading Substation 4 and 9 to 115 kV Through Substation 18

Existing. Substation 18 is located outside of Building 120. This substation consists of a 12.5 MVA, 115 kV-4.16 kV transformer and outdoor switchgear which formerly fed Building 120. This substation was installed to power a supersonic wind tunnel, but is presently not operational. This substation is individually metered by BG&E at a primary voltage of 115 kV. Due to the fact that this substation is metered at 115 kV, there are no distribution demand charges associated with the loads that are connected to this substation.

Using the individual metering data performed in October, 1995 the distribution demand for substations 4 and 9 during 1994-95 was 61,235 kW/yr at an annual cost of $140,000 a year. Estimates were made on summer and winter demands based on the results of the testing. Refer to attached sheet.

Distribution Electric Demand	=	61,235 kW/yr (Attached Sheet)
Dist. Electric Cost	=	$140,000 (60,847 kW/yr x 2.33/kW = $142,678, use $140,000).

Proposed. Construct and maintain secondary feeders from Substation 18 to Substations 4 and 9 which operate at 4.16 kV. Because the power is received at 115 kV it is not subject to distribution demand charges under BG&E's Schedule P rate. Therefore this charge drops to zero ($0). Refer to the purposed one-line diagram on the following page.

Implementation Cost Estimates.	The estimated construction costs for this project is $520,000. (Refer to the attached cost estimate)

Material	$ 300,000
Labor	$ 150,000
Engineering	$ 70,000

Savings. The yearly energy cost savings resulting from implementation of this project is estimated to be $140,000 ($140,000 - $0).

Electric Usage	=	0 kWh/yr (0 kWh/yr - 0 kWh/yr)
Energy Usage	=	0 mmBtu/yr (0 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

Discussion. The simple payback period for this ECO is 3.7 years ($520,000÷$140,000). The Savings to Investment Ratio (SIR) is 3.6. The LCCID calculation are located in Attachment 8.9.

This ECO would not be recommended if either ECO-1 or ECO-3 are implemented. These ECO's would eliminate the distribution demand charges associated with these particular substations and eliminate the annual savings associated with this ECO.

ECO-2
Upgrading Substation 4 & 9 to 115 kV

DEMAND PROFILE - OCTOBER 1995

Time	Distribution Demand(kW)			Time	Distribution Demand(kW)		
	Sub. 4	Sub. 9	TOTAL		Sub. 4	Sub. 9	TOTAL
12:00 AM	1,686	594	2,280	12:00 PM	2,853	636	3,488
12:30 AM	1,618	594	2,212	12:30 PM	2,808	638	3,447
01:00 AM	1,616	589	2,205	01:00 PM	2,816	1,053	3,869
01:30 AM	1,600	598	2,198	01:30 PM	2,873	1,053	3,926
02:00 AM	1,635	616	2,251	02:00 PM	2,824	1,028	3,852
02:30 AM	1,620	608	2,228	02:30 PM	2,851	993	3,844
03:00 AM	1,624	613	2,237	03:00 PM	2,805	975	3,779
03:30 AM	1,659	622	2,280	03:30 PM	2,711	932	3,643
04:00 AM	1,688	623	2,311	04:00 PM	2,497	868	3,365
04:30 AM	1,805	616	2,420	04:30 PM	2,248	772	3,019
05:00 AM	1,872	611	2,483	05:00 PM	2,109	728	2,836
05:30 AM	1,973	608	2,581	05:30 PM	2,060	716	2,776
06:00 AM	2,101	621	2,723	06:00 PM	2,058	738	2,796
06:30 AM	2,388	605	2,992	06:30 PM	2,151	737	2,888
07:00 AM	2,534	629	3,163	07:00 PM	2,194	732	2,926
07:30 AM	2,698	615	3,313	07:30 PM	2,178	717	2,895
08:00 AM	2,763	641	3,404	08:00 PM	2,146	705	2,852
08:30 AM	2,812	634	3,445	08:30 PM	2,096	681	2,777
09:00 AM	2,888	627	3,515	09:00 PM	2,046	664	2,710
09:30 AM	2,905	667	3,572	09:30 PM	1,936	658	2,594
10:00 AM	2,923	662	3,585	10:00 PM	1,831	648	2,478
10:30 AM	2,911	655	3,566	10:30 PM	1,781	631	2,412
11:00 AM	2,899	636	3,534	11:00 PM	1,756	623	2,379
11:30 AM	2,870	642	3,512	11:30 PM	1,695	599	2,295

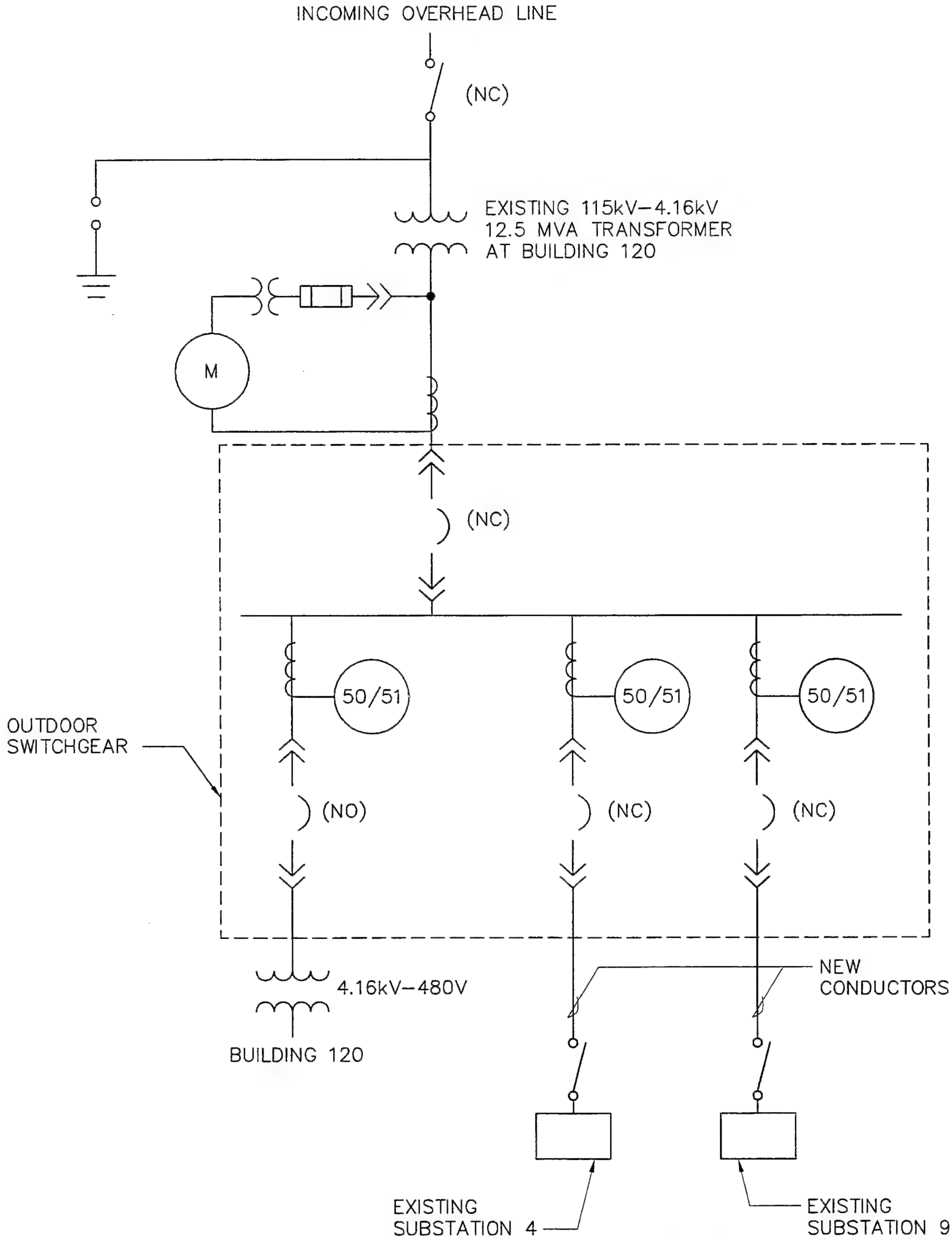
DEMAND SAVINGS

Month	Distrib Demand	Cost $
Oct	3,926	$9,147
Nov	4,312	$10,046
Dec	4,604	$10,728
Jan	5,110	$11,906
Feb	5,771	$13,446
Mar	5,190	$12,092
Apr	4,564	$10,635
May	4,857	$11,317
Jun	5,509	$12,836
Jul	6,028	$14,046
Aug	5,962	$13,891
Sep	5,403	$12,588
Total	61,235	$140,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED 11-Apr-96	SHEET 1 OF 1

PROJECT Aberdeen Proving Grounds - ECO 2	BASIS FOR ESTIMATE [X] CODE A (NO DESIGN COMPLETED) [ ] CODE B (PRELIMINARY DESIGN) [ ] CODE C (FINAL DESIGN) [ ] OTHER (SPECIFY)______
LOCATION Aberdeen, MD	
ARCHITECT ENGINEER ENTECH ENGINEERING, INC.	
DRAWING NO. G:\PROJECTS\4130.06\SS\ECOCOSTS.WK / ESTIMATOR JSP	CHECKED BY

ELECTRICAL SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
SUBSTATION							
Medium Voltage Circuit Breakers	2	EA	$29,800.00	$59,600	$3,675.00	$7,350	$66,950
Protective Relaying	2	EA	$1,200.00	$2,400	$400.00	$800	$3,200
Terminations	9	EA	$735.00	$6,615	$253.00	$2,277	$8,892
Outdoor Enclosure	1	LOT	$10,000.00	$10,000	$2,000.00	$2,000	$12,000
Equipment Pad	1	LOT	$2,500.00	$2,500	$1,000.00	$1,000	$3,500
FEEDERS							
Substation 4							
Poles	8	EA	$1,800.00	$14,400	$1,500.00	$12,000	$26,400
Conductors	3	MI	$12,300.00	$33,210	$2,500.00	$6,750	$39,960
Terminations	3	EA	$735.00	$2,205	$253.00	$759	$2,964
Group-Operated Disconnect	1	EA	$3,325.00		$1,245.00	$1,245	$1,245
Underbuilt Pole Hardware	19	EA	$300.00	$5,700	$445.00	$8,455	$14,155
Ground Wire	0.40	MI	$2,125.00	$850	$2,245.00	$898	$1,748
Steel Modifications	1.00	LOT	$3,500.00	$3,500	$2,250.00	$2,250	$5,750
Substation 9							
Poles	4.00	EA	$1,800.00	$7,200	$1,500.00	$6,000	$13,200
Conductors	3	MI	$5,100.00	$17,340	$1,880.00	$6,392	$23,732
Terminations	6	EA	$735.00	$4,410	$253.00	$1,518	$5,928
Group-Operated Disconnect	1.0	EA	$3,325.00	$3,325	$1,245.00	$1,245	$4,570
Underbuilt Pole Hardware	22	EA	$300.00	$6,600	$445.00	$9,790	$16,390
Ground Wire	1.20	MI	$2,125.00	$2,550	$2,245.00	$2,694	$5,244
Steel Modifications	1.00	LOT	$3,500.00	$3,500	$2,250.00	$2,250	$5,750
SUBTOTAL				$185,905		$75,673	$261,578
FRINGES @ 28%						$21,188	$21,188
OVERHEAD & PROFIT @ 20%				$37,181		$19,372	$56,553
DESIGN CONTINGENCY @ 25%				$55,772		$29,058	$84,830
SUPERVISION @ 5%				$13,943		$7,265	$21,207
ENGINEERING @ 15%							$70,000
TOTAL THIS SHEET				$300,000		$150,000	$520,000



ABERDEEN PROVING GROUNDS

ABERDEEN MARYLAND

UTILIZE SUBSTATION 18
ECO–2

ENTECH Engineering Inc.

4 SOUTH FOURTH STREET P.O. BOX 32 READING, PA 19603 (610) 373–6667
1851 WEST END AVE P.O. BOX 389 POTTSVILLE, PA 17901 (717) 628–5655

DATE	DRAWN BY	CHECKED BY	PROJ. MGR.	APPROVED	
1/5/96	RJI	JSP	DEH		
SCALE	PROJECT NO.		DRAWING NO.		REVISION
NO SCALE	4130.06		ECO–2		0

ECO-3
Upgrading Substation 18

Existing. The Base currently has three feeders which provide power throughout the Base. Two of the feeders are fed from the BG&E owned Harford Substation. These feeders are metered at 34 kV and feed Substations A and B. These two feeders distribute power throughout the Base and terminate at Substation 16 where switching can be performed to permit the entire base to be fed from either one of the feeders. The third feeder is metered at 115 kV and feeds Substation 18. The past electric bills indicate that this feeder has been out-of-service since May, 1995. The Base owns and maintains all electrical distribution equipment downstream of these metering points.

The rate structure states any service metered at less than 115 kV is subject to a distribution demand charge. This charge is based on the maximum kW of demand recorded during any of the rating periods for each month.

Using the BG&E "Loadstart Billing Interface Data", Substation B accounts for 55% of the Base distribution demand. The annual distribution demand for Substation B was 151,822 kW/yr at an annual cost of $350,000 a year. Refer to attached sheet.

Distribution Electric Demand	=	151,855 kW/yr (Attached Sheet)
Dist. Electric Cost	=	$350,000 (151,855 kW/yr x 2.33/kW = $353,822, use $350,000).

Proposed. Upgrade the existing Substation 18 located adjacent to building 120 with a 20 MVA, 115 kV-34.5 kV transformer and associated protective devices. A 34.5 kV feeder from the new substation would then be provided to Substation 16. This new feeder would replace one of the existing feeders. The size of the 115 kV service conductors prohibits supplying power to the entire Base from this

substation.

Because the power is received at 115 kV it is not subject to distribution demand charges under BG&E's Schedule P rate. Therefore this charge drops to zero ($0). Refer to the purposed one-line diagram on the following page.

Implementation Cost Estimates. The estimated construction costs to upgrade this substation is $1,500,000. (Reference the attached cost estimate)

Material	$ 1,100,000
Labor	$ 200,000
Engineering	$ 200,000

Savings. The yearly cost savings resulting from implementation of this project is estimated to be $350,000 ($350,000 - $0).

Electric Usage	=	0 kWh/yr (0 kWh/yr - 0 kWh/yr)
Energy Usage	=	0 mmBtu/yr (0 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

Discussion. The simple payback period for this ECO is 4.3 years ($1,500,000÷$350,000). The Savings to Investment Ratio (SIR) is 3.1. The LCCID calculation are located in Attachment 8.9.

This ECO would not be recommended if either ECO-1 or ECO-2 are implemented. These ECO's would eliminate the distribution demand charges associated with these particular substations and eliminate the annual savings associated with this ECO.

ECO-3
Aberdeen Proving Grounds
Upgrading Substation 18

Distribution Demand, kW	Substation B Demand, kW	Cost $
17,700	9,735	$22,683
19,440	10,692	$24,912
20,760	11,418	$26,604
23,040	12,672	$29,526
26,020	14,311	$33,345
23,400	12,870	$29,987
20,580	11,319	$26,373
21,900	12,045	$28,065
24,840	13,662	$31,832
27,180	14,949	$34,831
26,880	14,784	$34,447
24,360	13,398	$31,217
276,100	151,855	$350,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED 11-Apr-96	SHEET 1 OF 1

PROJECT
Aberdeen Proving Grounds - ECO 3

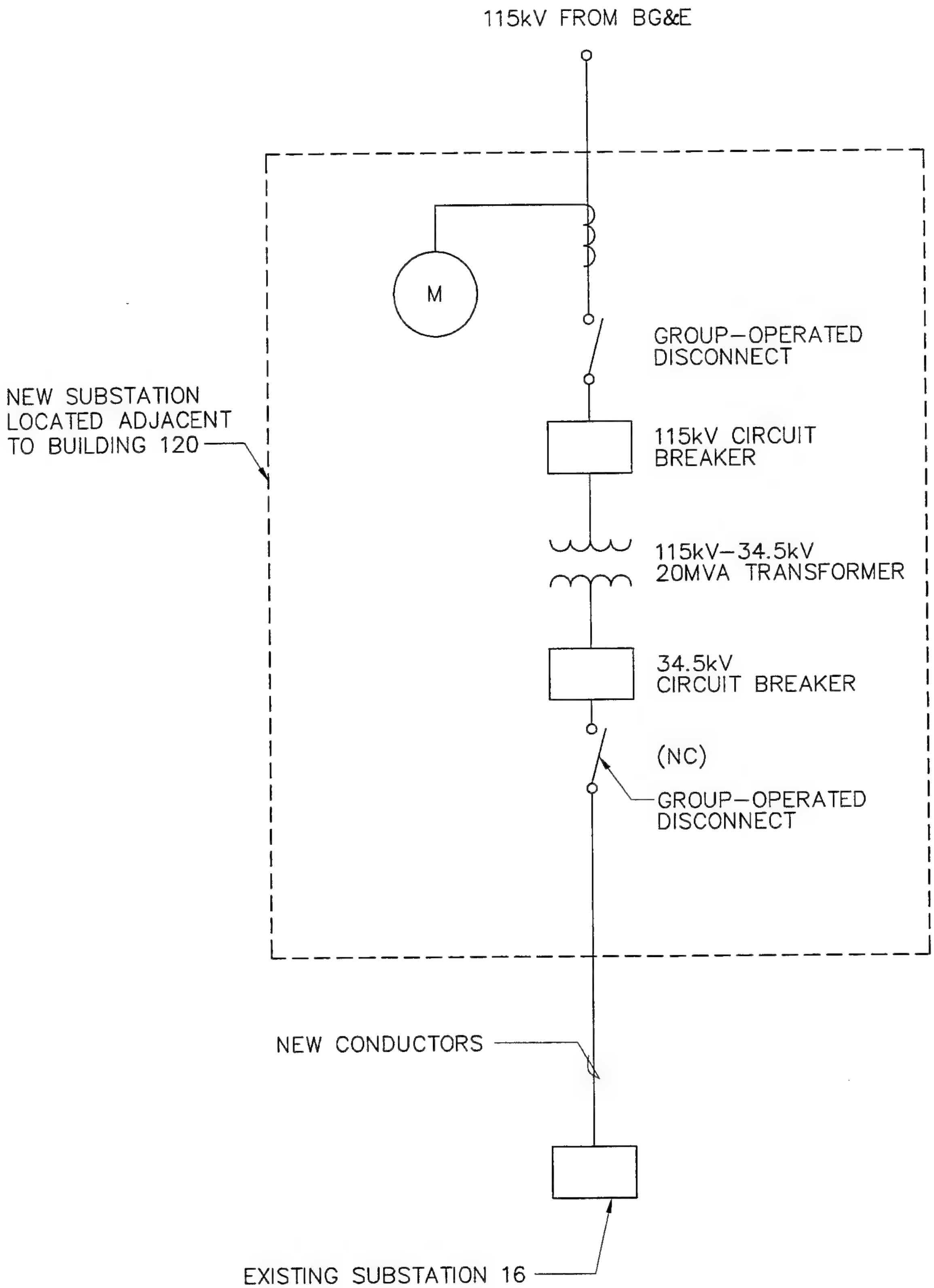
LOCATION
Aberdeen, MD

ARCHITECT ENGINEER
ENTECH ENGINEERING, INC.

BASIS FOR ESTIMATE
[X] CODE A (NO DESIGN COMPLETED)
[ ] CODE B (PRELIMINARY DESIGN)
[ ] CODE C (FINAL DESIGN)
[ ] OTHER (SPECIFY)

DRAWING NO. G:\PROJECTS\4130.06\SS\ECOCOSTS.WK
ESTIMATOR JSP
CHECKED BY

ELECTRICAL SUMMARY	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SUBSTATION							
20 MVA, 115kV-34.5kV Xfmr	1	EA	$197,500.00	$197,500	$12,700.00	$12,700	$210,200
115kV Oil Circuit Breaker	1	EA	$147,500.00	$147,500	$12,800.00	$12,800	$160,300
34.5kV Oil Circuit Breaker	1	EA	$41,500.00	$41,500	$2,725.00	$2,725	$44,225
Site Grounding	1	LOT	$8,000.00	$8,000	$6,000.00	$6,000	$14,000
Structural Steel	1	LOT	$20,000.00	$20,000	$8,000.00	$8,000	$28,000
Fencing	250	LF	$5.55	$1,388	$4.14	$1,035	$2,423
Equipment Pads	1	LOT	$15,000.00	$15,000	$10,000.00	$10,000	$25,000
Protective Relaying Enclosure	1	EA	$8,000.00	$8,000	$1,200.00	$1,200	$9,200
Protective Relaying	1	LOT	$12,000.00	$12,000	$7,000.00	$7,000	$19,000
Station Service Transformer	1	EA	$49,000.00	$49,000	$366.00	$366	$49,366
Battery Charger/Batteries	1	LOT	$2,500.00	$2,500	$450.00	$450	$2,950
Busswork	300	LF	$485.00	$145,500	$45.50	$13,650	$159,150
SECONDARY FEEDER							
Substation 16							
Poles(incl. crossarms & insulators)	8	EA	$1,400.00	$11,200	$2,300.00	$18,400	$29,600
Conductors	1	MILE	$5,100.00	$5,100	$1,880.00	$1,880	$6,980
Terminations	6	EA	$735	$4,410	$253.00	$1,518	$5,928
SUBTOTAL				$668,598		$97,724	$766,322
FRINGES @ 28%						$27,363	$27,363
OVERHEAD & PROFIT @ 20%				$133,720		$25,017	$158,737
DESIGN CONTINGENCY @ 25%				$200,579		$37,526	$238,105
SUPERVISION @ 5%				$50,145		$9,382	$59,526
ENGINEERING @ 15%							$200,000
TOTAL THIS SHEET				$1,100,000		$200,000	$1,500,000



ABERDEEN PROVING GROUNDS	ENTECH Engineering Inc. 4 SOUTH FOURTH STREET P.O. BOX 32 READING, PA 19603 (610) 373-6667 1851 WEST END AVE P.O. BOX 389 POTTSVILLE, PA 17901 (717) 628-5655					
ABERDEEN MARYLAND	DATE 2/2/96	DRAWN BY RJI	CHECKED BY JSP	PROJ. MGR. DEH	APPROVED	
UPGRADE SUBSTATION 18 ECO-3	SCALE NO SCALE	PROJECT NO. 4130.06		DRAWING NO. ECO-3		REVISION 0

ECO-4
Emergency Generation Rider

Existing. Baltimore Gas & Electric currently has an emergency generation program which is available under the primary rate schedule. This rider enables customers to receive credits for displacing electric loads through the use of emergency generators when requested by BG&E. BG&E is able to exercise this program a maximum of 12 days/year and a maximum of 10 hours/day on each occurrence.

A credit of $7.87/kW is applied to the monthly service bill for each kW of emergency generation capacity during the summer months and a credit of $2.04/kW is applied to the monthly bill for the non-summer months. In return, the customer must operate the emergency generators enrolled in this program within two hours of being notified by BG&E.

BG&E has also established penalties within this program in the event that the customer fails to generate at the Contract Capacity for the full duration of any generation period initiated by BG&E. These penalties may be reduced based upon the Customer's proportion of the number of successful compliances over the current and two prior requests by BG&E.

Proposed. Apply for the emergency generation program. Records suggest that the Base has 32 emergency generators with a total capacity of approximately 3,900 kW. Refer to the attached table for a listing of the base emergency generators and their respective building locations.

For the purpose of this ECO, three buildings with emergency generators were evaluated. The connected load on each of the generators was assumed to be 50% of the generator nameplate capacity. The buildings which were chosen are shown on the following page:

Building	Generation Capacity (kW)	Connected Load (kW)
314	100	50
345	165	80
3660	440	220

Coordination with the utility is required to ensure that metering equipment suitable to BG&E requirements are installed for each of the emergency generators enrolled in this program. BG&E will contribute $25 for each kW of expected emergency generation towards the installation of metering equipment. Costs in excess of the utility's contribution would be paid by the government.

The (3) three emergency generators will provide 350 kW of load. The Base is expected to reduce annual electric usage by 42,000 kWh. Fuel oil to operate two generators will be 1,280 gallons per year. The emergency generator located at Building 3660 was evaluated based on natural gas usage and requires 291 mcf/yr. Total energy cost savings will be $11,700. (Refer to attached table)

Usage Reduction	=	42,000 kWh/yr (350 kW/yr x 120 hr)
Electric Savings	=	$1,700 ((350 kW/yr x 120 hours) x $0.040/kWh = $1,722, use $1,700)
Fuel Oil Usage	=	1,280 gallons/yr (((130 kW/yr x 120 hours) x 3,413 Btu/kWh) ÷ (138,700 Btu/gal ÷ 30% eff for gen))
Fuel Oil Cost	=	$900 (1,280 gal/yr x $0.70/gal = $896, use $900)
Gas Usage	=	291 mcf/yr (((220 kW/yr x 120 hours) x 3,413 Btu/kWh) ÷ (1,031,000 Btu/mcf ÷ 30% eff for gen))

Gas Cost	=	$1,500 (291 mcf/yr x $5.26/gal = $1,530, use $1,500)
Labor Cost	=	$4,300 ($120/day x 12 days x 3 gen = $4,320, use $4,300)
Summer Credit	=	$11,000 (350 kW x $7.87/kW x 4 months = $11,018, use $11,000)
Non-Summer Credit	=	$5,700 (350 kW x $2.04/kW x 8 months = $5,712, use $5,700)

Implementation Cost Estimate. There are no construction costs for this ECO. All emergency generators are existing. The costs for adding the metering equipment should be covered by BG&E's stipend. Implementation of this ECO requires only operational and procedural changes.

Savings. The annual cost savings resulting from implementation of this project is $11,700 and was determined by evaluating the credits applied to the monthly service bill as a result of this rider and the costs associated with operation of each of the emergency generators.

For the purpose of this evaluation, the maximum number of hours allowed in this program was assumed, 120 hours. Savings will vary depending upon the actual number of hours each emergency generator is operated for any particular year.

Electric Usage	=	42,000 kWh/yr
Gas Usage	=	-291 mcf/yr
Fuel Oil Usage	=	-1,280 gal/yr
Energy Usage	=	-334 mmBtu/yr (42,000 kWh/yr x 3,413 Btu/kWh) - (291 mcf/yr x 1,031,000 Btu/mcf) - (1,279 gal/yr x 138,700

Btu/gal) ÷ 1,000,000 Btu/mmBtu

Discussion. The payback period for this ECO is immediate.

Implementation of this ECO would involve establishing operational and procedural changes to ensure that emergency generators can be reliably started upon being notified by BG&E.

The assumption that the connected load on each of the emergency generators is half of the capacity of the generator should be confirmed by either the production of as-built drawings or by actual on-site metering.

ECO-4
Aberdeen Proving Grounds
Emergency Generators

Building Location	Capacity (kW)	Manufacturer	Physical Location Description
Airport	175	Onan	
PAAF	15	Fermont	
Wood Pt.	15	Fermont	
300	25	Kohler	Fire Company
311	400	Onan	Telephone Exchange Building
314	100	Kohler	Admin. Office Building
315	2.5	Onan	Machine Shop
316	285	Caterpillar	ADP Building
345	165	Empire	Heat Plant Building
	360	Kohler	
398	200	Fermont	Sew/W Tr Pl Building
413	150	Fermont	
469	30	Onan	
861	125	Cummings	NUC Prop Facility
862	15	Kohler	Sentry Station
	50	Katolight	
1050	12	Onan	
1060	175	Onan	MNT Hangar Avum
1063	75	Cummings	Power Plant Bldg.
	75	GE	
1089	30	Caterpillar	Veh Mnt Sh Org
1103	15	Fermont	Ordinance Facility
1134	90	E.G.Wilson	Weather Station
2101	30	Onan	PM Admin Bldg.
2502	150	Delco	Hospital
	150	Detroit	
2916	25	Fermont	Housing Area
3400	20	Kohler	Commissary
3660	100	Kohler	Refrigeration Building
	360		
	440		
10201	5	Lima	Water Pump Station
TOTAL	3,865		

ECO-4
Aberdeen Proving Grounds
Emergency Generation Rider

Building Location	Generator Nameplate Data Voltage	Generator Nameplate Data KW	Conn. Load (kW)	Electric Bill Credits Summer(1)	Electric Bill Credits Non-Summer(2)	Savings Usage, kWh Savings(4)	Savings Total Savings	Generation Costs Fuel Cost(3)	Generation Costs Labor Costs	Generation Costs Total Costs	Yearly Savings
314	120/208	100	50	$1,574	$816	$246	$2,636	$344	$1,440	$1,784	$852
345	120/208	165	80	$2,518	$1,306	$394	$4,218	$551	$1,440	$1,991	$2,226
3660	277/480	440	220	$6,926	$3,590	$1,082	$11,598	$1,532	$1,440	$2,972	$8,626
Totals		705	350	$11,000	$5,700	$1,700	$18,400	$2,400	$4,300	$6,700	$11,700

(1) Based on $7.87/kw (4 months)
(2) Based on $2.04/kw (8 months)
(3) Assumes diesel fuel oil costs of $0.70/gallon and natural gas costs of $5.26/mcf.
(4) Based on 120 hours (12 days, 10 hours maximum)

Incremental Usage Cost = $0.040/kWh

ECO-5
BG&E's Curtailment Service Rider

Existing. Baltimore Gas & Electric currently has a curtailment program which is available under the primary service rate schedule. This program enables customers to receive **lower demand and on-peak usage charges** in return for shedding a specified load when requested by the utility. The table below displays the new curtailment rate structure.

Curtailment Rate Structure

Description	*Summer*	*Non-Summer*
Incremental Demand Charges		
Production & Trans - kW	$3.95	$1.91
Distribution - kW	$2.33	$2.33
Incremental Usage Charges		
On-Peak - kWh	$0.03969	$0.03555
Intermediate-Peak - kWh	$0.04040	$0.03335
Off-Peak - kWh	$0.02766	$0.02572
Super-Peak - kWh (Above Contract)	$0.71130	$0.71130
Super-Peak - kWh (Below Contract)	$0.05017	$0.03484

This program requires that both a summer Contract Demand and a Non-Summer Contract Demand be established between the customer and BG&E. This Contract Demand must be at least 5,000 kW below the customer's maximum measured demand.

During curtailment specified periods, the customer must be able to lower its demand requirements at or below the Contract Demand within 15 minutes of being notified by the utility. The utility is able to exercise this option a maximum of 12 days/year and a maximum of 10 hours/day on each occurrence.

From the attached table, the Bases', typical annual On-Peak electric demand is 276,900 kW and usage is 38,816,152 kWh. The annual On-Peak electric cost for the Base is $3,900,000.

Electric Demand	=	276,900 kW/yr (Attached Sheet)
Electric Usage	=	38,816,152 kWh/yr (Attached Sheet)
Electric Cost	=	$3,900,000 (173,640 kW/yr x $5.99/kW) + (103,260 kW/yr x $12.09/kW)+ (21,581,136 kWh/yr x $0.036/kWh) + (17,235,016 kWh/yr x $0.051/kWh) = $3,944,424 ,use $3,900,000.

Proposed. Contact BG&E to obtain approval to enroll in this curtailment program. Preliminary inquiries with BG&E have indicated that the base would be considered for this program. Establish a summer Contract Demand and a non-summer Contract Demand with BG&E. (See attached rider schedule and Attachment 8.1)

It is proposed to install four standby diesel generators sized at 1.8 MW each on the base. In addition the installation will include required protective relaying, switchgear, and transformation equipment required to interface with the existing electrical distribution equipment on the base. Refer to purposed attached one-line diagram.

The generators would operate to ensure that the Contract Demand established with BG&E is not exceeded during the curtailment periods. The generators would be remotely started when notified of a curtailment period by BG&E.

The fourth generator would serve as a backup to the three primary generators. As previously indicated, penalties exist if the Contract Demand is exceeded. For the purposes of these penalties this analysis it is assumed that no penalties are incurred.

From the attached table, the rider is expected to lower electric demand to 276,900 kW/yr and electric usage to 37,616,152 kWh/yr. The annual energy cost for the retrofit is $2,100,000.

Electric Demand	=	276,900 kW/yr (Attached Sheet)
Electric Usage	=	36,230,900 kWh/yr (Attached Sheet)
Curtailment Usage	=	1,985,252 kWh/yr ((17,235,016 kWh/yr ÷ (10 hrs/day x 5 days/wk x 16 wks)) - 5,000 kW) x 120 hours)
Gen Production	=	600,000 kWh/yr (5,000 kW x 120 hours
Total Usage	=	37,616,152 kWh/yr (36,230,900 kWh/yr + 1,985,252 kWh/yr - 600,000 kWh/yr)
Electric Cost	=	$2,100,000 (173,640 kW/yr x $1.91/kW) + (103,260 kW/yr x $3.95/kW)+ (21,581,137 kWh/yr x $0.033/kWh) + (14,649,763 kWh/yr x $0.040/kWh) + (1,985,252 kWh/yr x $0.050/kWh) - (600,000 x $0.051/kWh) = $2,106,360 ,use $2,100,000.

There will be a reduction in electric usage but not in billing demand. There will be a 600,000 kWh/yr reduction in usage due to operation of the generator.

Fuel costs are necessary to implement the curtailment program. The total fuel oil consumed by the generators for 120 hours of operation is 49,200 gallon/yr. The total fuel cost for the maximum 120 hours of curtailment use is $30,000/yr.

Fuel Oil Usage	=	49,200 gal/yr (((5,000 kW/yr x 120 hours) x 3,413 Btu/kWh) ÷ (138,700 Btu/gal ÷ 30% eff for gen))

Fuel Oil Cost	=	\$30,000 (49,200 gal/yr x \$0.070/gal = \$34,440, use \$30,000)
Total Cost	=	\$2,100,000 (\$2,100,000 - \$31,000 + \$30,000 = \$2,099,000, use \$2,100,000)

Implementation Cost Estimate. The estimated construction costs for this project is $4,890,000 ,use $4.9 million. (Reference the attached cost estimate)

Material	\$3,600,000
Labor	\$ 650,000
Engineering	\$ 640,000

Savings. The annual cost savings resulting from implementation of this project is estimated to be $1.8 million ($3,900,000 - $2,100,000). This amount is based on the actual demand and on-peak usage charges for Aberdeen fiscal year 1994-95 and utilizing the rate structure for this program. For the purpose of this evaluation, the maximum number of super-peak energy period hours allowable under this program was assumed.

Electric Demand	=	0 kW/yr (276,900 kW/yr - 276,900 kW/yr)
Electric Usage	=	600,000 kWh/yr (38,816,152 kWh/yr - 38,216,152 kWh/yr)
Fuel Oil Usage	=	-49,200 gal/yr
Energy Usage	=	-4,776 mmBtu/yr (600,000 kWh/yr x 3,413 Btu/kWh) - (49,200 gal/yr x 138,700 Btu/gal) ÷ 1,000,000 Btu/mmBtu)

Discussion. The expected payback resulting from implementation of this ECO is 2.7 years ($4,900,000÷$1,800,000). The Savings to Investment Ratio (SIR) is 4.9. The LCCID calculation are located in

Attachment 8.9.

It should be noted that in the rate structure, BG&E states the program is experimental and is limited to 3 participants. Initial inquiries with BG&E have indicated that Aberdeen base would be eligible for this program and currently there is only one customer participating. Also the contract only lasts for 2 years.

As an option, the Base should evaluate their existing operating procedures and practices to determine if all or a portion of the required curtailable load could be achieved by adjustments to operational procedures.

These generators could also be used for peak shaving during on-peak periods as long as it can be ensured that they will be available for use during super-peak energy periods. If a decision was made to utilize the generators for peak shaving purposes, natural gas would be recommended. However, use of generators for peak shaving can impact the curtailment economics.

This evaluation did not take into account the depreciation of the generators. Diesel generators have a life expectancy of (7) seven years.

A preventative maintenance program will need to be established for the new generators and switchgear, which is not established in this evaluation. It is estimated that a yearly cost of $35,000 will be required to facilitate the required preventative maintenance.

ECO-5
Aberdeen Proving Grounds
Curtailment Rider Savings

OCTOBER 1994 - SEPTEMBER 1995

	Existing Conditions			Proposed Curtailment Rider Rate Structure								Savings
Month	Distrib. Demand	On-Peak Usage	Total Cost	On-Peak Usage	Super-Peak Usage	Generator Prod. Usage	Total Usage	Electric Cost	Fuel Oil Gallons	Fuel Oil Cost	Total Cost	Total Savings
October	17,700	2,346,967	$190,514	2,346,967	0	0	2,346,967	$110,412	0	$0	$110,412	$80,102
November	19,440	2,624,416	$210,925	2,624,416	0	0	2,624,416	$122,791	0	$0	$122,791	$88,133
December	21,120	2,631,487	$221,242	2,631,487	0	0	2,631,487	$126,231	0	$0	$126,231	$95,011
January	23,400	2,884,895	$244,022	2,884,895	0	0	2,884,895	$138,857	0	$0	$138,857	$105,165
February	26,400	3,233,728	$274,550	3,233,728	0	0	3,233,728	$155,973	0	$0	$155,973	$118,577
March	23,400	2,802,634	$241,061	2,802,634	0	0	2,802,634	$136,172	0	$0	$136,172	$104,889
April	20,940	2,467,763	$214,270	2,467,763	0	0	2,467,763	$120,543	0	$0	$120,543	$93,727
May	21,240	2,589,246	$220,440	2,589,246	0	0	2,589,246	$125,081	0	$0	$125,081	$95,359
June	24,840	3,974,633	$503,022	3,378,438	446,195	150,000	3,974,633	$248,640	12,304	$8,612	$257,253	$245,769
July	27,180	4,802,092	$573,513	4,081,778	570,314	150,000	4,802,092	$292,026	12,304	$8,612	$300,638	$272,874
August	26,880	4,604,218	$559,794	3,913,585	540,633	150,000	4,604,218	$282,676	12,304	$8,612	$291,289	$268,506
September	24,360	3,854,073	$491,070	3,275,962	428,111	150,000	3,854,073	$241,770	12,304	$8,612	$250,382	$240,688
Totals	276,900	38,816,152	$3,900,000	36,230,900	1,985,252	600,000	38,816,152	$2,100,000	49,200	$30,000	$2,100,000	$1,800,000

Note: Based on a total super-peak energy period of 120 hours.

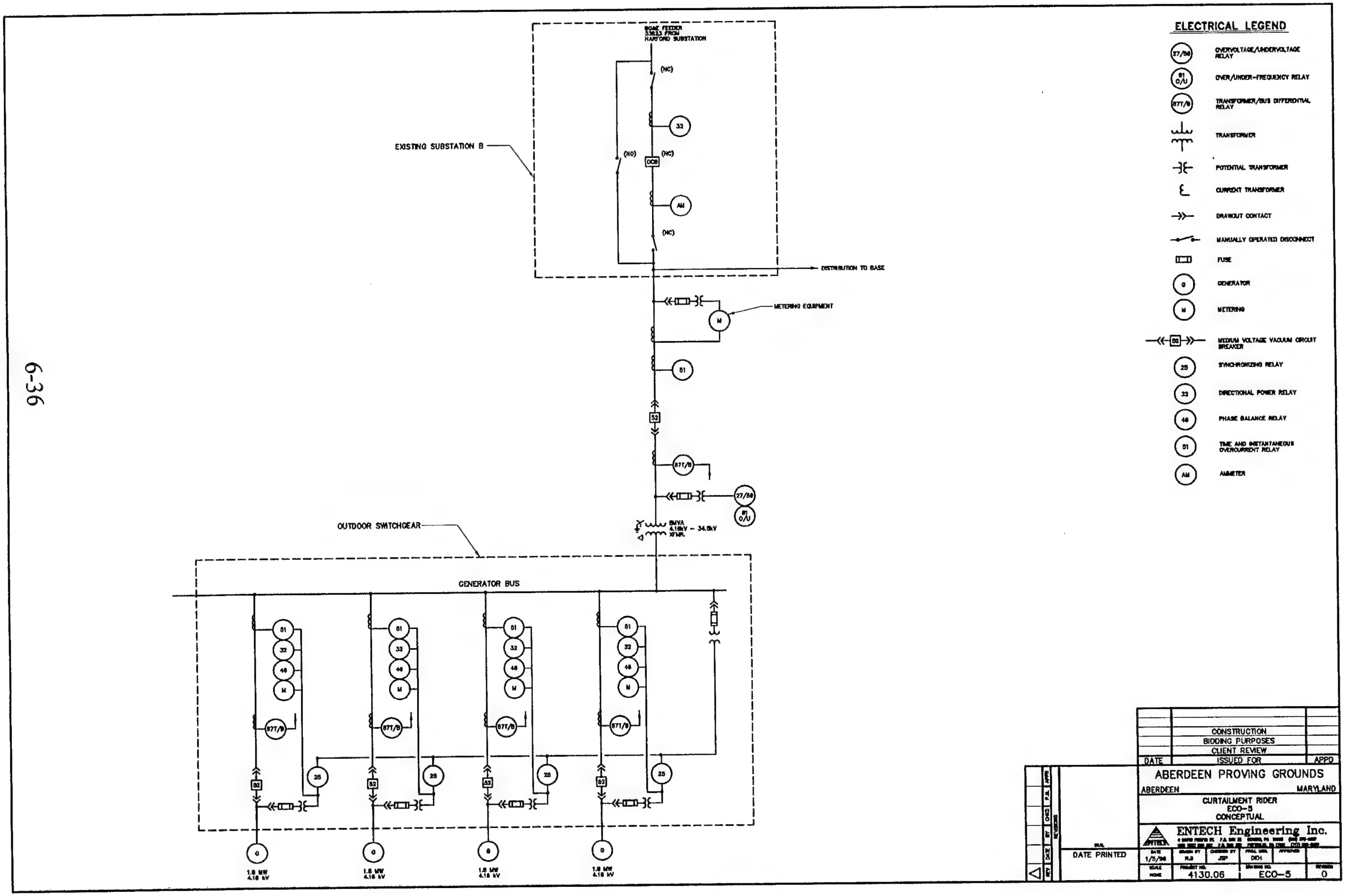
	Summer		Non-Summer	
	Schedule P	Curtailmant	Schedule P	Curtailmant
Incremental Demand Charges - kW				
Production & Transmission	$12.09	$3.95	$5.99	$1.91
Distribution	$2.33	$2.33	$2.33	$2.33
Incremental Usage Charges - kWh				
On-Peak	$0.05088	$0.05088	$0.03555	$0.03555
Intermediate-Peak	$0.04040	$0.04040	$0.03335	$0.03335
Off-Peak	$0.02766	$0.02766	$0.02572	$0.02572
Super-Peak (Above Contract Demand)	N/A	$0.71130	N/A	$0.71130
Super-Peak (Below Contract Demand)	N/A	$0.05017	N/A	$0.03484

CONSTRUCTION COST ESTIMATE	DATE PREPARED 11-Apr-96	SHEET 1 OF 1

PROJECT	BASIS FOR ESTIMATE
Aberdeen Proving Grounds - ECO 5	[X] CODE A (NO DESIGN COMPLETED)
LOCATION Aberdeen, MD	[ ] CODE B (PRELIMINARY DESIGN)
ARCHITECT ENGINEER ENTECH ENGINEERING, INC.	[ ] CODE C (FINAL DESIGN)
	[ ] OTHER (SPECIFY)________

DRAWING NO.	ESTIMATOR	CHECKED BY
G:\PROJECTS\4130.06\SS\ECOCOSTS.WK	JSP	

ELECTRICAL SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
Site Work							
Grading	4000	SY	$2.00	*$8,000*	$1.00	*$4,000*	*$12,000*
Stone Backfill	4000	SY	$1.10	*$4,400*	$1.60	*$6,400*	*$10,800*
Fencing	800	LF	$5.55	*$4,440*	$4.14	*$3,312*	*$7,752*
Concrete Equipment Pads	95	CY	$88.00	*$8,360*	$48.15	*$4,574*	*$12,934*
Site Grounding	1	LOT	$12,000.00	*$12,000*	$6,500.00	*$6,500*	*$18,500*
Standby Generators							
Diesel Generator	4	EA	$445,000.00	*$1,780,000*	$48,500.00	*$194,000*	*$1,974,000*
4.16kV Conductors	5	CLF	$540.00	*$2,700*	$190.00	*$950*	*$3,650*
Terminations	24	EA	$225.00	*$5,400*	$200.00	*$4,800*	*$10,200*
Trenching/Backfilling	275	LF	$2.80	*$770*	$2.04	*$561*	*$1,331*
Conduit	540	LF	$13.85	*$7,479*	$11.40	*$6,156*	*$13,635*
Weatherproof Enclosure	4	EA	$24,000.00	*$96,000*	$3,500.00	*$14,000*	*$110,000*
4.16kV Outdoor Switchgear							
Medium Voltage Circuit Breaker	4	EA	$29,800.00	*$119,200*	$3,675.00	$14,700	$133,900
Protective Relaying	22	EA	$1,250.00	$27,500	$850.00	$18,700	$46,200
Misc. P.T.'s/C.T.'s	14	EA	$2,250.00	$31,500	$182.50	$2,555	$34,055
Weatherproof Enclosure	1	EA	$14,500.00	*$14,500*	$2,500.00	*$2,500*	*$17,000*
Transformation Equipment							
Transformer - 8 MVA	1	EA	$90,400	*$90,400*	$4,688.00	*$4,688*	*$95,088*
4.16kV Conductors	8	CLF	$540.00	*$4,320*	$190.00	*$1,520*	*$5,840*
34.5kV Conductors	7	CLF	$470.00	*$3,290*	$163.00	*$1,141*	*$4,431*
Terminations	18	EA	$225.00	*$4,050*	$200.00	*$3,600*	*$7,650*
Trenching/Backfilling	450.0	LF	2.80	*$1,260*	$2.04	*$918*	*$2,178*
Conduit	900	LF	13.85	$12,465	$11.40	*$10,260*	*$22,725*
34.5kV Outdoor Switchgear							
Medium Voltage Circuit Breaker	1	EA	$29,800.00	$29,800	$3,675.00	$3,675	$33,475
Protective Relaying	4.00	EA	$1,250.00	$5,000	$850.00	$3,400	$8,400
Misc. P.T's/C.T.'s	5	EA	$2,250.00	*$11,250*	$182.50	*$913*	*$12,163*
Weatherproof Enclosure	1	EA	$8,500.00	*$8,500*	$2,000.00	*$2,000*	*$10,500*
34.5kV Conductors	6	CLF	$470.00	*$2,820*	$163.00	*$978*	*$3,798*
Terminations	6	EA	$225.00	*$1,350*	$200.00	*$1,200*	*$2,550*
Trenching/Backfilling	200	LF	$2.80	*$560*	$2.04	*$408*	*$968*
Conduit	200	LF	$13.85	*$2,770*	$11.40	*$2,280*	*$5,050*
Substation B Modifications							
Protective Relaying	1	EA	$1,400.00	*$1,400*	$1,000.00	*$1,000*	*$2,400*
Steel Modifications	1	LOT	$3,000.00	*$3,000*	$3,000.00	*$3,000*	*$6,000*
SUBTOTAL				*$2,300,084*		*$320,689*	*$2,620,773*
FRINGES @ 28%						*$89,793*	*$89,793*
OVERHEAD & PROFIT @ 20%				*$460,017*		*$82,096*	*$542,113*
DESIGN CONTINGENCY @ 25%				*$690,025*		*$123,144*	*$813,170*
SUPERVISION @ 5%				*$172,506*		*$30,786*	*$203,292*
ENGINEERING @ 15%							*$640,000*
TOTAL THIS SHEET				*$3,600,000*		*$650,000*	*$4,900,000*


ELECTRICAL LEGEND
OVERVOLTAGE/UNDERVOLTAGE RELAY
OVER/UNDER-FREQUENCY RELAY
TRANSFORMER/BUS DIFFERENTIAL RELAY
TRANSFORMER
POTENTIAL TRANSFORMER
CURRENT TRANSFORMER
DRAWOUT CONTACT
MANUALLY OPERATED DISCONNECT
FUSE
GENERATOR
METERING
MEDIUM VOLTAGE VACUUM CIRCUIT BREAKER
SYNCHRONIZING RELAY
DIRECTIONAL POWER RELAY
PHASE BALANCE RELAY
TIME AND INSTANTANEOUS OVERCURRENT RELAY
AMMETER
EXISTING SUBSTATION B
HARFORD SUBSTATION
(NC)
(NO)
DISTRIBUTION TO BASE
METERING EQUIPMENT
OUTDOOR SWITCHGEAR
GENERATOR BUS
1.8 MW 4.16 kV
1.8 MW 4.16 kV
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1.8 MW 4.16 kV
CONSTRUCTION
BIDDING PURPOSES
CLIENT REVIEW
DATE
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ABERDEEN PROVING GROUNDS
ABERDEEN
MARYLAND
CURTAILMENT RIDER
ECO-5
CONCEPTUAL
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ECO-6
Peak Shaving with Emergency Generators

Existing. The Base presently has 32 emergency generators with a total capacity of approximately 3,900 kW. These generators are presently exercised in the event of utility power failure.

Proposed. It is proposed to exercise the existing emergency generators located at Buildings 314, 345, and 3660 during on-peak periods of the BG&E summer rating period. This will eliminate the Production and Transmission distribution demand charges for the loads associated with these buildings. The connected load on each of the generators was assumed to be 50% of the generator nameplate capacity.

Building	Generation Capacity (kW)	Connected Load (kW)
314	100	50
345	165	80
3660	440	220

Operational and procedural changes will be required to ensure that the generators are exercised during on-peak periods and to shut the generators down at the completion of the on-peak period.

The (3) three emergency generators will provide 350 kW of load. The Base is expected to reduce annual electric demand by 1,400 kW and usage by 308,000 kWh. Fuel oil to operate two generators will be 9,384 gallons per year. The emergency generator located at Building 3660 was evaluated based on natural gas usage and requires 2,136 mcf/yr. Total energy cost savings will be $10,100. (Refer to attached table)

Electric Demand = 1,400 kW/yr (350 kW x 4 mo)

Usage Reduction = 308,000 kWh/yr (350 kW x 880 hrs)

Electric Savings	=	\$32,600 ((1,400 kW/yr x \$12.09/kW) + (308,000 kWh/yr x \$0.051/kWh = \$32,634, use \$32,600)
Fuel Oil Usage	=	9,384 gallons/yr (((130 kW/yr x 880 hours) x 3,413 Btu/kWh) ÷ (138,700 Btu/gal ÷ 30% eff for gen))
Fuel Oil Cost	=	\$6,600 (9,384 gal/yr x \$0.70/gal = \$6,570, use \$6,600)
Gas Usage	=	2,136 mcf/yr (((220 kW/yr x 880 hours) x 3,413 Btu/kWh) ÷ (1,031,000 Btu/mcf ÷ 30% eff for gen))
Gas Cost	=	\$11,200 (2,136 mcf/yr x \$5.26/gal = \$11,235, use \$11,200)
Controller Cost	=	\$1,100 (\$350/control x 3/gen = \$1,050, use \$1,100)

Implementation Cost Estimate. Timer controls will be required to be installed in each of the automatic transfer switches associated with these emergency generators. These controls will initiate operation of the emergency generator during BG&E's on-peak rating period. The cost to install these controls is estimated to be \$350 for each building.

Savings. The annual cost savings resulting from implementation of this project was determined by evaluating the demand and usage savings and the costs required to exercise the generators.

Electric Demand	=	1,400 kW/yr
Electric Usage	=	308,000 kWh/yr
Gas Usage	=	-2,136 mcf/yr

Fuel Oil Usage	=	-9,384 gal/yr
Energy Usage	=	-2,453 mmBtu/yr (308,000 kWh/yr x 3,413 Btu/kWh) - (2,136 mcf/yr x 1,031,000 Btu/mcf) - (9,384 gal/yr x 138,700 Btu/gal) ÷ 1,000,000 Btu/mmBtu

Discussion. The simple payback period for each of the buildings in this ECO is less than 1 month. The Savings to Investment Ratio (SIR) is 111.1. The LCCID calculation are located in Attachment 8.9.

This evaluation did not take into account the depreciation of each of the emergency generators. This ECO requires the generators to be exercised 880 hours during the summer rating period. The base should evaluate this in determining whether or not to implement this ECO.

The assumption that the connected load on each of the emergency generators is half of the capacity of the generator should be confirmed by either the production of as-built drawings or by actual on-site metering.

ECO-6
Aberdeen Proving Grounds
Peak Shaving Demand

Building Location	Generator Nameplate Data		Conn. Load	Summer Electric Savings			Emergency Generation Costs				Yearly Savings
	Voltage	kW		Demand Savings	Usage Savings	Total	Fuel Quantity	Fuel Costs (1)	Control Costs	Total Costs	
314	120/208	100	50	$2,418	$2,244	$4,662	3,609 gal.	$2,526	$350	$2,876	$1,786
345	120/208	165	80	$3,869	$3,590	$7,459	5,775 gal.	$4,042	$350	$4,392	$3,067
3660	277/480	440	220	$10,639	$9,874	$20,513	2,136 mcf	$11,237	$350	$11,587	$8,926
Totals		705	350	$16,900	$15,700	$32,600		$17,800	$1,100	$18,900	$13,800

Incremental Demand Cost	$12.09/kW
Incremental Usage Cost	$0.051/kWh

(1) Assumes diesel fuel oil costs of $0.70/gallon and natural gas costs of $5.26/mcf.

ECO-7
Electric Clothes Dryers to Natural Gas

Existing

The laundry facility in each of the barracks buildings listed below contain electric clothes dryers with 5.9 kW of electric heat per dryer. The dryers appear to be in good condition. It will be assumed that each soldier washes two loads of laundry each week, and each load will require approximately 45 minutes of drying time. The table below lists each barracks with quantities of dryers and soldiers.

Building #	*# of Dryers*	*# of Personnel*
4210	15	96
4211	15	96
4213	10	96
4218	12	161
4220	14	160
4307	15	96
4309	15	96
Totals	96	801

The electric demand (kW) from the dryers is estimated to be 680 kW/yr at a cost of $7,000/yr.

Electric Demand = 680 kW/yr (5.9 kW/dryer x 96 dryers x 12 mo/year x 10%) = 679.7 kW/yr, use 680 kW/yr

Electric Demand Cost = $7,000/yr (5.9 kW/dryer x 96 dryers x 8 mo/non-summer demand x $8.32/kW x 10%) + (5.9 kW/dryer x 96 dryers x 4 mos./summer demand x $14.42/kW x 10%) = $7,037/yr, use $7,000/yr

The annual electric energy (kWh) usage is 368,620 kWh at a cost of $12,300.

Electric Usage	=	368,620 kWh/yr (Non-summer - 0.75 hrs/load x 2 loads/wk x 35 wks x 5.9 kW/dryer x 801 soldiers) + (Summer - 0.75 hrs/load x 2 loads/wk x 17 wks x 5.9 kW/dryer x 801 soldiers) = 368,620 kWh/yr
Electric Cost	=	$12,300 (248,110 kWh x $0.030/kWh) + (120,510 kWh x $0.040/kWh) = $12,264, use $12,300
Total Electric Cost	=	$19,300 ($12,300 + $7,000)

Proposed

It will be assumed that underground gas piping is installed to a point of 5'-0" outside each of the buildings. The only new gas piping to be installed will be from this point to the dryers. Dryer purchase is sequenced as part of an O&M project.

1. Remove existing (96) ninety-six electric dryers as they fail and replace with gas dryers.

2. Electric circuits including wiring, receptacles, and breakers sized for 120 volt service will replace existing 240 volt feeds.

3. New gas piping from stubbed gas pipe connection outside the Buildings, to each building and dryer.

4. Existing dryer vents will be reused.

Based upon the same usage, the new gas dryers will use approximately 1,745 mcf per year for an annual energy cost of $9,200.

Gas Usage	=	1,745 mcf/yr (368,620 kWh/yr x 3,413 Btu/kWh ÷ 1,030,000 Btu/mcf ÷ 70% eff. = 1,745 mcf
Gas Cost	=	$9,200/yr (1,745 mcf/yr x $5.26/mcf = $9,179, use $9,200)

Implementation Cost Estimate

The expected construction cost for this project will be $79,000. This price includes only the cost difference between purchasing new electric dryers and new gas dryers assuming that new dryers will need to be purchased. Reference attached cost estimate.

Material	$ 33,000
Labor	$ 35,000
Engineering	$ 10,000

Savings

The annual cost savings resulting from the implementation of this project will be $10,100 ($19,300 - $9,200).

Electric Demand	=	680 kW/yr (680 kW/yr - 0 kW/yr)
Electric Usage	=	368,620 kWh/yr (368,620 kWh/yr - 0 kWh/yr)
Gas Usage	=	-1,745 mcf/yr (0 mcf/yr - 1,745 mcf/yr)
Energy Usage	=	-541 mmBtu/yr (368,620 kWh/yr x 3,413 Btu/kWh - 1,745 mcf/yr x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

Discussion

The payback period for this ECO will be 7.8 years ($79,000÷$10,100). The Savings to Investment Ratio (SIR) is 1.3. The LCCID calculation are located in Attachment 8.9. This is not eligible for a demand reduction ECO; however, if a summer steam system shutdown is implemented, gas-fired domestic water heaters will be installed in each building requiring gas piping and pressure regulators to be installed. This would reduce costs to implement this ECO and would make replacing the electric dryers with gas-

fired dryers as an O&M project more attractive

CONSTRUCTION COST ESTIMATE	DATE PREPARED 11-Apr-96	SHEET 1 OF 1
PROJECT: Aberdeen Proving Grounds - ECO 7 - Elec Dryers to Gas	BASIS FOR ESTIMATE: [X] CODE A (NO DESIGN COMPLETED) [ ] CODE B (PRELIMINARY DESIGN) [ ] CODE C (FINAL DESIGN) [ ] OTHER (SPECIFY)______	
LOCATION: Aberdeen, MD		
ENTECH ENGINEERING, INC.		
DRAWING NO.: G:\PROJECTS\4130.06\SS\ECOCOSTS.WK	ESTIMATOR: ESG	CHECKED BY

MECHANICAL SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
MECHANICAL							
Gas Piping:							
Indoor							
1"	1000	L.F.	$3.16	*$3,160*	$3.06	*$3,060*	*$6,220*
Gas Dryer less Electric Dryer	96	EA	$100.00	*$9,600*	$50.00	*$4,800*	*$14,400*
Excavation	2620	L.F.	$0.25	*$655*	$0.26	*$681*	*$1,336*
Gas Shut-off Valves:							
1/2"	96	EA	$6.15	*$590*	$10.00	*$960*	*$1,550*
1-1/4"	7	EA	$20.50	*$144*	$16.05	*$112*	*$256*
Pressure Regulators - 1-1/4"	7	EA	$475.00	*$3,325*	$18.65	*$131*	*$3,456*
ELECTRICAL							
Circuit Breaker - 1P, 20A	48	EA	$10.95	*$526*	$23.50	*$1,128*	*$1,654*
Duplex Receptacles	96	EA	$2.15	*$206*	$5.85	*$562*	*$768*
#12 Wiring	28	CLF	$5.90	*$165*	$21.50	*$602*	*$767*
3/4" Conduit	2100	L.F.	$1.37	*$2,877*	$2.60	*$5,460*	*$8,337*
SUBTOTAL				*$21,248*		*$17,496*	*$38,744*
FRINGES @ 28%						*$4,899*	*$4,899*
OVERHEAD & PROFIT @ 20%				*$4,250*		*$4,479*	*$8,729*
CONTINGENCY @ 25%				*$6,374*		*$6,718*	*$13,093*
SUPERVISION @ 5%				*$1,594*		*$1,680*	*$3,273*
ENGINEERING @ 15%							*$10,000*
TOTAL THIS SHEET				*$33,000*		*$35,000*	*$79,000*

ECO-8
Disable or Redirect Sensor for Doors at Building 3660

Existing. Automatic doors are generally recommended in facilities where lift trucks are used, such as Building 3660 - Cold/Dry Storage. Each of the cooler and freezer doors in building 3660 is fitted with a sensor for automatic operation and an automatic air curtain. Although an air curtain reduces the loss of refrigerated air, it is no substitute for a closed door.

We observed during our January 3, 1996 site visit that the doors to the perishable cooler (32 °F to 35 °F), the sensitive vegetable and fruit cooler (32 °F to 34 °F), and the hardy vegetable and fruit cooler (40 °F to 45 °F) open readily when there is activity in the warehouse aisle. The doors surely open when lift trucks are stocking or removing product from the dry storage racks along this aisle. The door operation was timed. Each door stays open for 30 seconds when activated. The attached sketch shows the approximate existing sensor settings.

Proposed. Reduce loss of refrigerated air by disabling or redirecting the sensors for the automatic doors along the dry storage aisle. The manual pull chain option should remain operational.

Implementation Cost Estimate. There are no construction costs required for implementation of this ECO. The labor costs to disable or redirect/reprogram the sensors is $240 based on one hour per door for each member of a two man crew at $40/hour.

Savings. The annual cost savings resulting from implementation of this project was determined by evaluating the amount of energy lost by having a door open unnecessarily. We have assumed that each of the three doors is inadvertently opened four times an hour when racks along the aisle are being filled.

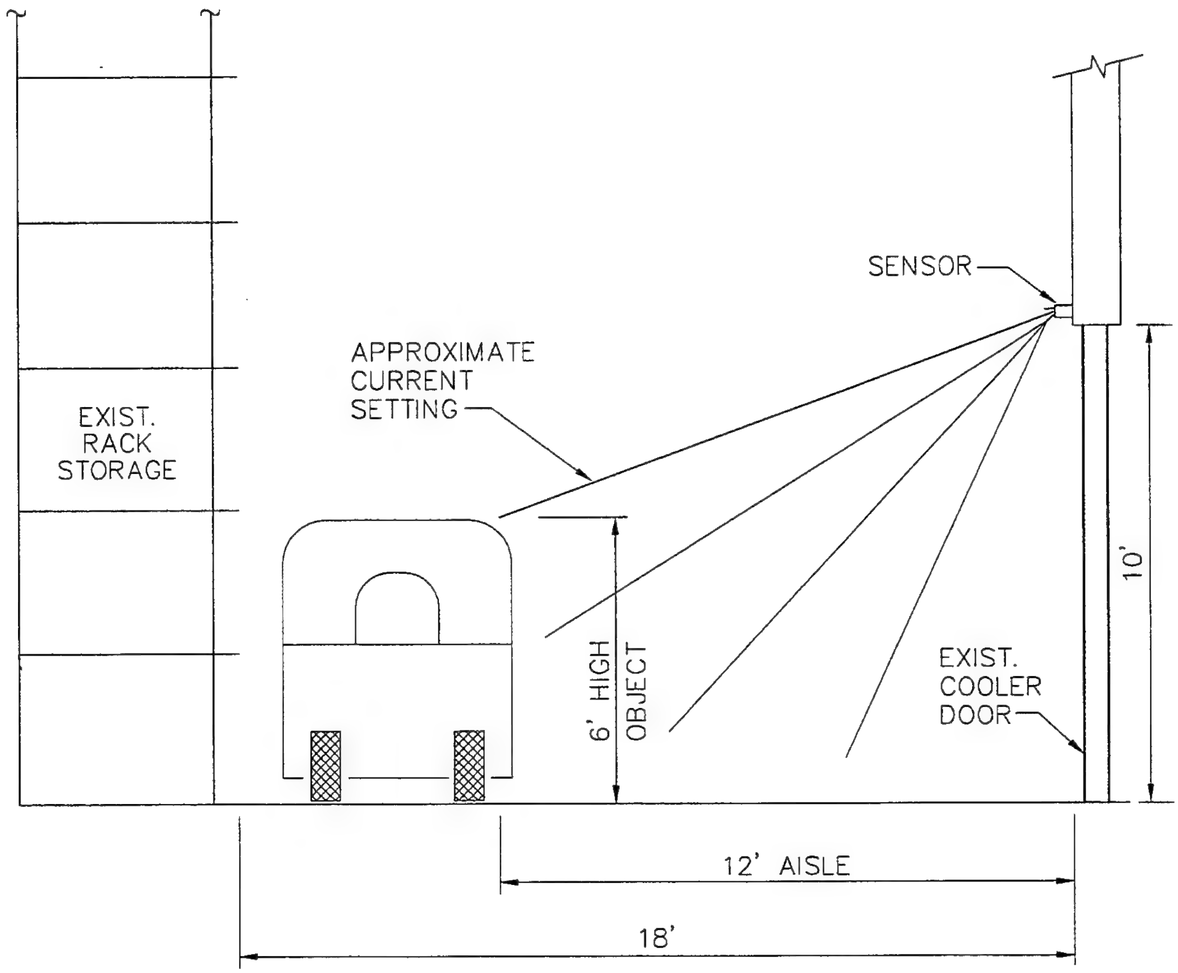
Demand Savings = 0.075 kW/yr

Usage Savings	=	675 kWh/yr
Cost Savings	=	\$30 (0.075 kW x \$8.32/kW x 8 months + 0.075 kW x \$14.42/kW x 4 months) + (0.075 kW x 5,880 hours/year x 0.70 diversity x \$0.030/kWh + 0.075 x 2,880 hours/year x 0.70 diversity x \$0.040/kWh = \$25, use \$30)
Energy Usage	=	2 mmBtu/yr (675 kWh/yr x 3,413 Btu/kWh) ÷ 1,000,000 Btu/mmBtu

Discussion. The simple payback for this ECO is estimated to be 8.0 years (\$240÷\$30). The Savings to Investment Ratio (SIR) is 1.7. The LCCID calculation are located in Attachment 8.9.

It is questionable whether each of the three doors will be open unnecessarily for two minutes an hour for every hour of the year. Nevertheless, it is also almost impossible to quantify the impact of humidity on defrost and compressor operation. On a design day, approximately 2.8 pounds of moisture enters the cooler every time a door is opened. This moisture builds up on the coils as frost, reducing the effectiveness of the coils and causing the electrical defrost cycle to operate for longer periods. The electrical cost associated with power to open each door is also unknown and was not considered in this evaluation.

Although the savings available from this ECO are quite small and the impact on base demand is negligible, this low cost/no cost ECO that should be considered for improved operation of the Cold/Dry Storage facility.



APPROXIMATE EXISTING SENSOR SETTINGS

NOT TO SCALE

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE BASED ON VISUAL OBSERVATIONS

ECO-9
Limit Use of Freezer Underfloor Warming System in Building 3660

Existing. Waste heat from the refrigeration system is recovered by a heat exchanger and circulated through a glycol grid system under the freezer floor. This underfloor heat is intended to prevent floor heavage. We estimate the amount of heat currently entering the freezer from the underfloor warming system and convection from the warm earth to be 64,000 BTU. Refer to the attached for cost determination.

Electric Demand	=	128 kW/yr (Attached Sheet)
Electric Usage	=	93,184 kWh/yr (Attached Sheet)
Electric Cost	=	$4,600 ($1,868 + $2,775 = $4,643, use $4,600)

Proposed. Turn one-half of the underfloor heating off. The system is looped such that there would not be any unprotected areas with one loop inactive. The amount of heat entering the freezer due to the warming system and convection from the warm earth would be reduced to 38,000 BTU. Refer to the attached worksheet for cost determination.

Electric Demand	=	76 kW/yr (Attached Sheet)
Electric Usage	=	55,328 kWh/yr (Attached Sheet)
Electric Cost	=	$2,800 ($1,109 + $1,649 = $2,758, use $2,800)

Implementation Cost Estimate. There are no construction costs required for implementation of this ECO. The labor costs to disable one half of the underfloor heating system was assumed to be minimal.

Savings. The annual cost savings resulting from implementation of this project will be $1,800 ($4,600 - $2,800).

Electric Demand	=	52 kW/yr (128 kW/yr - 76 kW/yr)
Electric Usage	=	37,856 kWh/yr (93,184 kWh/yr - 55,328 kWh/yr)
Energy Usage	=	129 mmBtu/yr (37,856 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

Discussion. This is a low cost/no cost ECO. Although the annual savings are tempting, the modification saves only an estimated 4 kW per month. This modification also leaves the facility vulnerable to a problem. The underfloor warming system was designed to limit the impact of a problem. If a glycol line leaked or some other problem caused one glycol line to be inoperative, the second line is positioned to warm the entire floor undersurface and prevent floor heaving.

ECO-9

Aberdeen Proving Grounds

Limit Underfloor Warming

EXISTING

	kW	Duration	Diversity	Unit Cost	Total kW	Total kWh	Cost
Summer							
Demand	10.7	4 mo.	1	$14.42	42.7		$616
On-Peak kWh	10.7	850 hrs.	1	$0.051		9,067	$462
Off-Peak kWh	10.7	510 hrs.	1	$0.028		5,440	$152
Intermediate kWh	10.7	1,496 hrs.	1	$0.040		15,957	$638
Winter							
Demand	10.7	8 mo.	1	$8.32	85.3		$710
On-Peak kWh	10.7	1,336 hrs.	1	$0.036		14,251	$513
Off-Peak kWh	10.7	1,002 hrs.	1	$0.025		10,688	$267
Intermediate kWh	10.7	3,542 hrs.	1	$0.034		37,781	$1,285
Totals					**128**	**93,184**	**$4,643**

PROPOSED

	kW	Duration	Diversity	Unit Cost	Total kW	Total kWh	Cost
Summer							
Demand	6.3	4 mo.	1	$14.42	25.3		$365
On-Peak kWh	6.3	850 hrs.	1	$0.051		5,383	$275
Off-Peak kWh	6.3	510 hrs.	1	$0.028		3,230	$90
Intermediate kWh	6.3	1,496 hrs.	1	$0.040		9,475	$379
Winter							
Demand	6.3	8 mo.	1	$8.32	50.7		$422
On-Peak kWh	6.3	1,336 hrs.	1	$0.036		8,461	$305
Off-Peak kWh	6.3	1,002 hrs.	1	$0.025		6,346	$159
Intermediate kWh	6.3	3,542 hrs.	1	$0.034		22,433	$763
Totals					**76**	**55,328**	**$2,757**

ECO-10
Electric Clothes Dryers to Natural Gas

Existing

The laundry facility in each of the barracks buildings listed below contain electric clothes dryers with 5.9 kW of electric heat per dryer. The dryers appear to be in good condition. It will be assumed that each soldier washes two loads of laundry each week, and each load will require approximately 45 minutes of drying time. The table below lists each barracks with quantities of dryers and soldiers.

Building #	*# of Dryers*	*# of Personnel*
4210	15	96
4211	15	96
4213	10	96
4218	12	161
4220	14	160
4307	15	96
4309	15	96
Totals	96	801

The electric demand (kW) from the dryers is estimated to be 680 kW/yr at a cost of $7,000/yr.

Electric Demand = 680 kW/yr (5.9 kW/dryer x 96 dryers x 12 mo/year x 10%) = 679.7 kW/yr, use 680 kW/yr

Electric Demand Cost = $7,000/yr (5.9 kW/dryer x 96 dryers x 8 mo/non-summer demand x $8.32/kW x 10%) + (5.9 kW/dryer x 96 dryers x 4 mos./summer demand x $14.42/kW x 10%) = $7,037/yr, use $7,000/yr

The annual electric energy (kWh) usage is 368,620 kWh at a cost of $12,300.

Electric Usage	=	368,620 kWh/yr (Non-summer - 0.75 hrs/load x 2 loads/wk x 35 wks x 5.9 kW/dryer x 801 soldiers) + (Summer - 0.75 hrs/load x 2 loads/wk x 17 wks x 5.9 kW/dryer x 801 soldiers) = 368,620 kWh/yr
Electric Cost	=	$12,300 (248,110 kWh x $0.030/kWh) + (120,510 kWh x $0.040/kWh) = $12,264, use $12,300
Total Electric Cost	=	$19,300 ($12,300 + $7,000)

Proposed

Replace the existing dryers with equivalent gas-fired dryers. The conversion involves the following:

1. Remove existing (96) ninety-six electric dryers and replace with gas dryers.

2. Electric circuits including wiring, receptacles, and breakers sized for 120 volt service will replace existing 240 volt feeds.

3. New underground gas piping from stubbed gas pipe connection outside Building 4219, to each building and dryer.

4. Existing dryer vents will be reused.

Based upon the same usage, the new gas dryers will use approximately 1,745 mcf per year for an annual energy cost of $9,200.

Gas Usage = 1,745 mcf/yr (368,620 kWh/yr x 3,413

Btu/kWh ÷ 1,030,000 Btu/mcf ÷ 70% eff. = 1,745 mcf

Gas Cost = $9,200/yr (1,745 mcf/yr x $5.26/mcf = $9,179, use $9,200)

Implementation Cost Estimate

The expected construction cost for this project will be $177,000. The cost includes new dryers, new electric work, and new gas piping. Reference attached cost estimate.

Material	$103,000
Labor	$ 51,000
Engineering	$ 23,000

Savings

The annual cost savings resulting from the implementation of this project will be $10,100 ($19,300 - $9,200).

Electric Demand = 680 kW/yr (680 kW/yr - 0 kW/yr)

Electric Usage = 368,620 kWh/yr (368,620 kWh/yr - 0 kWh/yr)

Gas Usage = -1,745 mcf/yr (0 mcf/yr - 1,745 mcf/yr)

Energy Usage = -541 mmBtu/yr (368,620 kWh/yr x 3,413 Btu/kWh - 1,745 mcf/yr x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu) =

Discussion

The payback period for this ECO will be 17.5 years ($177,000÷$10,100). The Savings to Investment Ratio (SIR) is 0.6. The LCCID calculation are located in Attachment 8.9.

CONSTRUCTION COST ESTIMATE

DATE PREPARED 23-Apr-96

SHEET 1 OF 1

PROJECT
Aberdeen Proving Grounds - ECO 10 - Elec Dryers to Gas

Aberdeen, MD

BASIS FOR ESTIMATE
[X] CODE A (NO DESIGN COMPLETED)
[ ] CODE B (PRELIMINARY DESIGN)
[ ] CODE C (FINAL DESIGN)
[ ] OTHER (SPECIFY)________

LOCATION
ENTECH ENGINEERING, INC.

DRAWING NO.
G:\PROJECTS\4130.06\SS\ECOCOSTS.WK

ESTIMATOR
ESG

CHECKED BY

MECHANICAL SUMMARY	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MECHANICAL							
Gas Piping:							
Outdoor							
2-1/2"	1,060	L.F.	$2.66	*$2,820*	$1.80	*$1,908*	*$4,728*
2"	600	L.F.	$1.42	*$852*	$1.50	*$900*	*$1,752*
1-1/2"	560	L.F.	$1.42	*$795*	$1.50	*$840*	*$1,635*
1-1/4"	400	L.F.	$3.60	*$1,440*	$3.28	*$1,312*	*$2,752*
Indoor							
1"	1,000	L.F.	$3.16	*$3,160*	$3.06	*$3,060*	*$6,220*
Gas Dryer	96	EA	$500.00	*$48,000*	$80.00	*$7,680*	*$55,680*
Excavation	2,620	L.F.	$0.25	*$655*	$0.26	*$681*	*$1,336*
Gas Shut-off Valves:							
1/2"	96	EA	$6.15	*$590*	$10.00	*$960*	*$1,550*
1-1/4"	7	EA	$20.50	*$144*	$16.05	*$112*	*$256*
Pressure Regulators - 1-1/4"	7	EA	$475.00	*$3,325*	$18.65	$131	$3,456
ELECTRICAL							
Circuit Breaker - 1P, 20A	48	EA	$10.95	*$526*	$23.50	*$1,128*	*$1,654*
Duplex Receptacles	96	EA	$2.15	*$206*	$5.85	*$562*	*$768*
#12 Wiring	28	CLF	$6	*$165*	$21.50	*$602*	*$767*
3/4" Conduit	2,100	L.F.	$1.37	*$2,877*	$2.60	*$5,460*	*$8,337*
SUBTOTAL				*$65,555*		*$25,336*	*$90,891*
FRINGES @ 28%						*$7,094*	*$7,094*
OVERHEAD & PROFIT @ 20%				*$13,111*		*$6,486*	*$19,597*
CONTINGENCY @ 25%				*$19,666*		*$9,729*	*$29,395*
SUPERVISION @ 5%				*$4,917*		*$2,432*	*$7,349*
ENGINEERING @ 15%							*$23,000*
TOTAL THIS SHEET				*$103,000*		*$51,000*	*$177,000*

ECO-11
Add Insulation to the Exterior Freezer Wall in Building 3660

Existing. The freezer is situated in the west corner of the Cold/Dry Storage facility. The freezer is insulated from direct sunlight by a service aisle that extends along the northwest and southwest exposure of the facility. The service aisle is uninsulated, but the freezer is protected by four inches of urethane panel on the ceiling and walls and six inches of extruded polystyrene insulation at the floor. Estimated heat loss through these exterior walls under design conditions is 16,200 BTUH. See attached worksheet for cost determination.

Electric Demand	=	24 kW/yr (Attached Sheet)
Electric Usage	=	13,107 kWh/yr (Attached Sheet)
Electric Cost	=	$750 ($417 + $333)

Proposed. Add one inch of extruded polystyrene (R=5) insulation to the freezer walls at the service corridor. Estimated heat loss through these exterior walls with the extra inch of insulation is 13,950 BTUH. See attached worksheet for cost determination.

Electric Demand	=	21 kW/yr (Attached Sheet)
Electric Usage	=	11,287 kWh/yr (Attached Sheet)
Electric Cost	=	$650 ($359 + $287 = $646, use $650)

Implementation Cost Estimate. The estimated construction cost for this project is $10,500. Refer to the attached cost estimate for details.

Materials	$7,700
Labor	$1,400
Engineering	$1,400

Savings.	The annual cost savings resulting from implementation of this project will be \$100 (\$750 - \$650).	
	Electric Demand =	3 kW/yr (24 kW/yr - 21 kW/yr)
	Electric Usage =	1,820 kWh/yr (13,107 kWh/yr - 11,287 kWh/yr)
	Energy Usage =	6 mmBtu/yr (1,820 kWh/yr x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

Discussion. The ECO has a simple payback of 105 years (\$10,500÷\$100). The Savings to Investment Ratio (SIR) is 0.1. The LCCID calculation are located in Attachment 8.9. The service corridor provides a fair amount of protection for heat gain in the freezer. It is not recommended to implement this ECO.

ECO-10
Aberdeen Proving Grounds
Add Insulation to Freezer Wall

EXISTING

	kW	Duration	Diversity	Unit Cost	Total kW	Total kWh	Cost
Summer							
Demand	2.7	4 mo.	1.00	$14.42	10.8		$156
On-Peak kWh	2.7	850 hrs.	0.90	$0.051		2,066	$105
Off-Peak kWh	2.7	510 hrs.	0.70	$0.028		964	$27
Intermediate kWh	2.7	1,496 hrs.	0.80	$0.040		3,231	$129
Winter							
Demand	2.7	8 mo.	0.60	$8.32	13.0		$108
On-Peak kWh	2.7	1,336 hrs.	0.50	$0.036		1,804	$65
Off-Peak kWh	2.7	1,002 hrs.	0.45	$0.025		1,217	$30
Intermediate kWh	2.7	3,542 hrs.	0.40	$0.034		3,825	$130
Totals					**23.8**	**13,107**	**$751**

PROPOSED

	kW	Duration	Diversity	Unit Cost	Total kW	Total kWh	Cost
Summer							
Demand	2.3	4 mo.	1.00	$14.42	9.3		$134
On-Peak kWh	2.3	850 hrs.	0.90	$0.051		1,779	$91
Off-Peak kWh	2.3	510 hrs.	0.70	$0.028		830	$23
Intermediate kWh	2.3	1,496 hrs.	0.80	$0.040		2,783	$111
Winter							
Demand	2.3	8 mo.	0.60	$8.32	11.2		$93
On-Peak kWh	2.3	1,336 hrs.	0.50	$0.036		1,553	$56
Off-Peak kWh	2.3	1,002 hrs.	0.45	$0.025		1,048	$26
Intermediate kWh	2.3	3,542 hrs.	0.40	$0.034		3,294	$112
Totals					**20.5**	**11,287**	**$647**

CONSTRUCTION COST ESTIMATE	DATE PREPARED 23-Apr-96	SHEET 1 OF 1

PROJECT
Aberdeen Proving Grounds - Add Insulation to Freezer Wall

Aberdeen, MD
LOCATION
ENTECH ENGINEERING, INC.

BASIS FOR ESTIMATE
[X] CODE A (NO DESIGN COMPLETED)
[ ] CODE B (PRELIMINARY DESIGN)
[ ] CODE C (FINAL DESIGN)
[ ] OTHER (SPECIFY)________

DRAWING NO. G:\PROJECTS\4130.06\SS\ECOCOSTS.WK

ESTIMATOR DAE

CHECKED BY

MECHANICAL SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
1" Polystyrene Insulation	5460	S.F.	$0.90	$4,914	$0.13	$710	$5,624
SUBTOTAL				$4,914		$710	$5,624
FRINGES @ 28%						$199	$199
OVERHEAD & PROFIT @ 20%				$983		$182	$1,165
CONTINGENCY @ 25%				$1,474		$273	$1,747
SUPERVISION @ 5%				$369		$68	$437
ENGINEERING @ 15%							$1,400
TOTAL THIS SHEET				$7,700		$1,400	$10,600

ECO-12
Ice Storage for Building 314

Existing. Building 314, the Ryan Office Building, is presently air conditioned by cold water from a 250 ton Trane Centravac water cooled chiller. This chiller is approximately ten years old and uses CFC-11 as a refrigerant. The Trane Company has informed us that this chiller cannot be converted to ice storage duty.

Entech learned during a January 3, 1996 site visit that a new York 400 ton air-cooled chiller is being installed to serve this building. York International provided us additional information about the chiller. The unit being installed is a Model YDAJ88XU6, with reciprocating compressors. This type of chiller can be readily converted to ice storage duty by modifying the controls and circulating 25%, by weight, propylene glycol.

From the attached sheets, the annual electric demand for the Post is 276,900 kW and usage is 129,763,000 kWh. Annual costs for the Post is $7,200,000. The following table describes existing energy use and costs for the Post based on 1994-1995 electrical data.

Season	*Demand kW*	*Off-Peak kWh*	*Intermediate kWh*	*On-Peak kWh*	*Cost $*
Non-Summer	173,640	42,745,875	17,407,989	21,581,136	$3,882,124
Summer	103,260	21,900,635	8,892,349	17,235,016	$3,336,907
Totals	276,900	64,646,510	26,300,338	38,816,152	$7,219,000

Proposed. Convert the 400 ton air-cooled chiller for ice storage duty and purchase ice storage tank(s) to supplement chiller use. Since the objective for this study is to reduce base-wide demand, Entech took an unconventional approach to sizing the ice storage. Peak base demands occur between 1:00 PM and 5:00 PM. Although peak cooling demands are expected to occur around 5:00 PM, the greatest impact on electrical demand is achieved by eliminating electrical use for cooling during the peak demand hours. 1,500

ton-hours of ice storage capacity is required to eliminate chiller operation between 1:00 PM and 5:00 PM. The attached figure shows the proposed operating strategy on the design day. On cooler days, ice storage can be used to satisfy a larger portion of the cooling load. It is advantageous to use as much ice as possible during the utility on-peak period because the cost per kWh is less during the intermediate and off-peak periods. The following table shows expected energy use and costs under the proposed operating strategy. The calculations to support these estimates are included in the attached table.

Season	*Demand kW*	*Off-Peak kWh*	*Intermediate kWh*	*On-Peak kWh*	*Cost $*
Non-Summer	173,117	42,793,731	17,367,495	21,581,135	$3,877,592
Summer	101,582	22,051,277	8,892,349	17,107,551	$3,310,427
Totals	274,699	64,845,008	26,259,844	38,688,686	$7,188,000

Implementation Cost Estimate. The costs associated with this project include converting the 400 ton air-cooled chiller to ice-making duty. The estimated total cost for this project is $340,000.

Materials	$208,000
Labor	$ 88,000
Engineering	$ 44,000

Savings. The annual cost savings resulting from implementation of this project result from moving demand and electrical usage from the on-peak to off-peak periods is $30,000 ($7,219,000 - $7,188,000 = $31,000, use $30,000). It takes more energy to produce ice than cold water. However, ice is produced during the utility off-peak periods, demand and energy costs are reduced. Refer to attached worksheet for determination of demand and usage costs.

Non-Summer kW = 523 kW/yr (173,640 kW/yr - 173,117 kW/yr)

Summer kW	=	1,678 kW/yr (103,260 kW/yr - 101,582 kW/yr)
Off-Peak kWh	=	-198,498 kWh/yr (64,646,510 kWh/yr - 64,845,008 kWh/yr)
Intermediate kWh	=	40,494 kWh/yr (26,300,338 kWh/yr - 26,259,844 kWh/yr)
On-Peak kWh	=	127,466 kWh/yr (38,816,152 kWh/yr - 38,688,686 kWh/yr)
Energy Usage	=	-104 mmBtu/yr ((-198,498 kWh/yr + 40,494 kWh/yr + 127,466 kWh/yr) x 3,413 Btu/kWh) ÷ 1,000,000 Btu/mmBtu

Discussion. The ECO has a simple payback of 11.3 years ($340,000÷$30,000). The Savings to Investment Ratio (SIR) is 1.2. The LCCID calculation are located in Attachment 8.9.

Mobile - Aberdeen Demand Reduction Study
Building 314 - Ryan Office Building
Energy Costs

Existing:

Demand

		KW	Unit Cost ($/KW)	Demand Cost
1995	Jan	23400	8.32	$194,688.00
	Feb	26400	8.32	$219,648.00
	Mar	23400	8.32	$194,688.00
	Apr	20940	8.32	$174,220.80
	May	21240	8.32	$176,716.80
	Jun	24840	14.42	$358,192.80
	Jul	27180	14.42	$391,935.60
	Aug	26880	14.42	$387,609.60
	Sep	24360	14.42	$351,271.20
1994	Oct	17700	8.32	$147,264.00
	Nov	19440	8.32	$161,740.80
	Dec	21120	8.32	$175,718.40
		276900		$2,933,694.00

Intermediate Period Usage

	KWH	Unit Cost ($/KWH)	Intermediate Usage Cost
Jan	2271744	0.034	$77,239.30
Feb	2511655	0.034	$85,396.27
Mar	2288892	0.034	$77,822.33
Apr	1999204	0.034	$67,972.94
May	2277204	0.034	$77,424.94
Jun	2085533	0.040	$83,421.32
Jul	2422091	0.040	$96,883.64
Aug	2366799	0.040	$94,671.96
Sep	2017926	0.040	$80,717.04
Oct	1955178	0.034	$66,476.05
Nov	2091784	0.034	$71,120.66
Dec	2012328	0.034	$68,419.15
	26300338		$947,565.59

On-Peak Period Usage

	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	2884895	0.036	$103,856.22
Feb	3233728	0.036	$116,414.21
Mar	2802634	0.036	$100,894.82
Apr	2467763	0.036	$88,839.47
May	2589246	0.036	$93,212.86
Jun	3974633	0.051	$202,706.28
Jul	4802092	0.051	$244,906.69
Aug	4604218	0.051	$234,815.12
Sep	3854073	0.051	$196,557.72
Oct	2346967	0.036	$84,490.81
Nov	2624416	0.036	$94,478.98
Dec	2631487	0.036	$94,733.53
	38816152		$1,655,906.71

Off-Peak Period Usage

	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	5480361	0.025	$137,009.03
Feb	6528617	0.025	$163,215.43
Mar	5239474	0.025	$130,986.85
Apr	5445033	0.025	$136,125.83
May	4818550	0.025	$120,463.75
Jun	4642834	0.028	$129,999.35
Jul	6455817	0.028	$180,762.88
Aug	5443983	0.028	$152,431.52
Sep	5358001	0.028	$150,024.03
Oct	4197855	0.025	$104,946.38
Nov	4878800	0.025	$121,970.00
Dec	6157185	0.025	$153,929.63
	64646510		$1,681,864.66

Proposed:

Demand

	Peak Ton	Chiller Rating (KW/ton)	Delta KW	KW	Unit Cost ($/KW)	Demand Cost
Jan	0	1.1	0	23400	8.32	$194,688.00
Feb	0	1.1	0	26400	8.32	$219,648.00
Mar	0	1.1	0	23400	8.32	$194,688.00
Apr	78	1.1	86	20854	8.32	$173,506.94
May	157	1.1	173	21067	8.32	$175,279.94
Jun	392	1.1	431	24409	14.42	$351,974.90
Jul	393	1.1	432	26748	14.42	$385,701.83
Aug	381	1.1	419	26461	14.42	$381,566.18
Sep	360	1.1	396	23964	14.42	$345,560.88
Oct	240	1.1	264	17436	8.32	$145,067.52
Nov	0	1.1	0	19440	8.32	$161,740.80
Dec	0	1.1	0	21120	8.32	$175,718.40
			2201	274699		$2,905,141.39

Intermediate Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KWH	KWH	Unit Cost ($/KWH)	Intermediate Usage Cost
Jan	0	30	0.7	1.1	0	2271744	0.034	$77,239.30
Feb	0	30	0.7	1.1	0	2511655	0.034	$85,396.27
Mar	0	30	0.7	1.1	0	2288892	0.034	$77,822.33
Apr	290	30	0.7	1.1	6699	1992505	0.034	$67,745.17
May	580	30	0.7	1.1	13398	2263806	0.034	$76,969.40
Jun	0	30	0.7	1.1	0	2085533	0.040	$83,421.32
Jul	0	30	0.7	1.1	0	2422091	0.040	$96,883.64
Aug	0	30	0.7	1.1	0	2366799	0.040	$94,671.96
Sep	0	30	0.7	1.1	0	2017926	0.040	$80,717.04
Oct	883	30	0.7	1.1	20397	1934781	0.034	$65,782.54
Nov	0	30	0.7	1.1	0	2091784	0.034	$71,120.66
Dec	0	30	0.7	1.1	0	2012328	0.034	$68,419.15
					40494	26259844		$946,188.78

On-Peak Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KWH	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	0	30	0.7	1.1	0	2884895	0.036	$103,856.22
Feb	0	30	0.7	1.1	0	3233728	0.036	$116,414.21
Mar	0	30	0.7	1.1	0	2802634	0.036	$100,894.82
Apr	0	30	0.7	1.1	0	2467763	0.036	$88,839.47
May	0	30	0.7	1.1	0	2589246	0.036	$93,212.86
Jun	1332	30	0.7	1.1	30769	3943864	0.051	$201,137.05
Jul	1453	30	0.7	1.1	33564	4768528	0.051	$243,194.91
Aug	1409	30	0.7	1.1	32548	4571670	0.051	$233,155.18
Sep	1324	30	0.7	1.1	30584	3823489	0.051	$194,997.92
Oct	0	30	0.7	1.1	0	2346967	0.036	$84,490.81
Nov	0	30	0.7	1.1	0	2624416	0.036	$94,478.98
Dec	0	30	0.7	1.1	0	2631487	0.036	$94,733.53
					127466	38688686		$1,649,405.96

Off-Peak Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KWH	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	0	30	0.7	1.3	0	5480361	0.025	$137,009.03
Feb	0	30	0.7	1.3	0	6528617	0.025	$163,215.43
Mar	0	30	0.7	1.3	0	5239474	0.025	$130,986.85
Apr	290	30	0.7	1.3	7917	5452950	0.025	$136,323.75
May	580	30	0.7	1.3	15834	4834384	0.025	$120,859.60
Jun	1332	30	0.7	1.3	36364	4679198	0.028	$131,017.53
Jul	1453	30	0.7	1.3	39667	6495484	0.028	$181,873.55
Aug	1409	30	0.7	1.3	38466	5482449	0.028	$153,508.56
Sep	1324	30	0.7	1.3	36145	5394146	0.028	$151,036.09
Oct	883	30	0.7	1.3	24106	4221961	0.025	$105,549.02
Nov	0	30	0.7	1.3	0	4878800	0.025	$121,970.00
Dec	0	30	0.7	1.3	0	6157185	0.025	$153,929.63
					198498	64845008		$1,687,279.04

Existing Total Cost = $2,933,694.00 + $947,565.59 + $1,655,906.71 + $1,681,864.66

$7,219,030.95

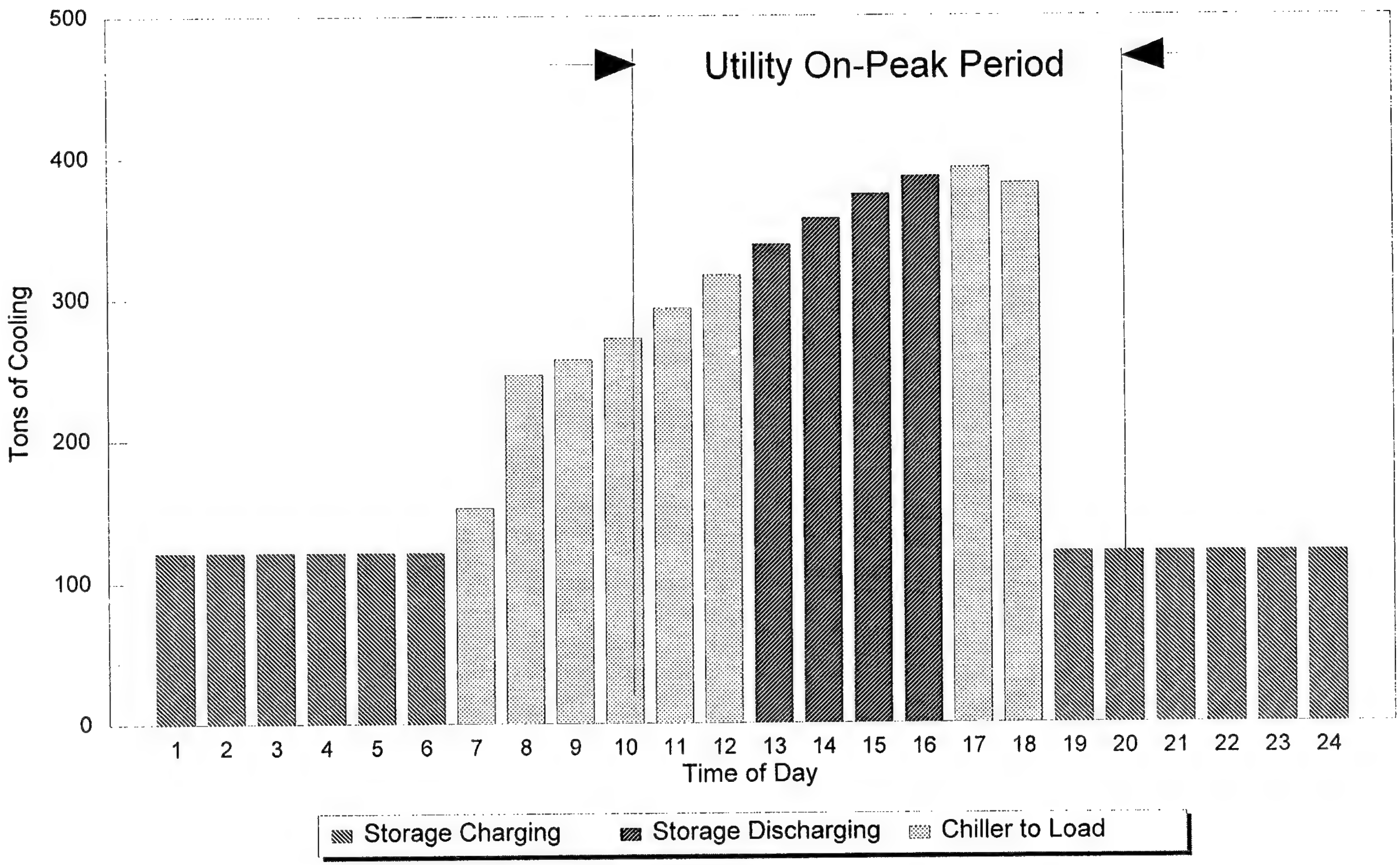
Proposed Total Cost = $2,905,141.39 + $946,188.78 + $1,649,405.96 + $1,687,279.04

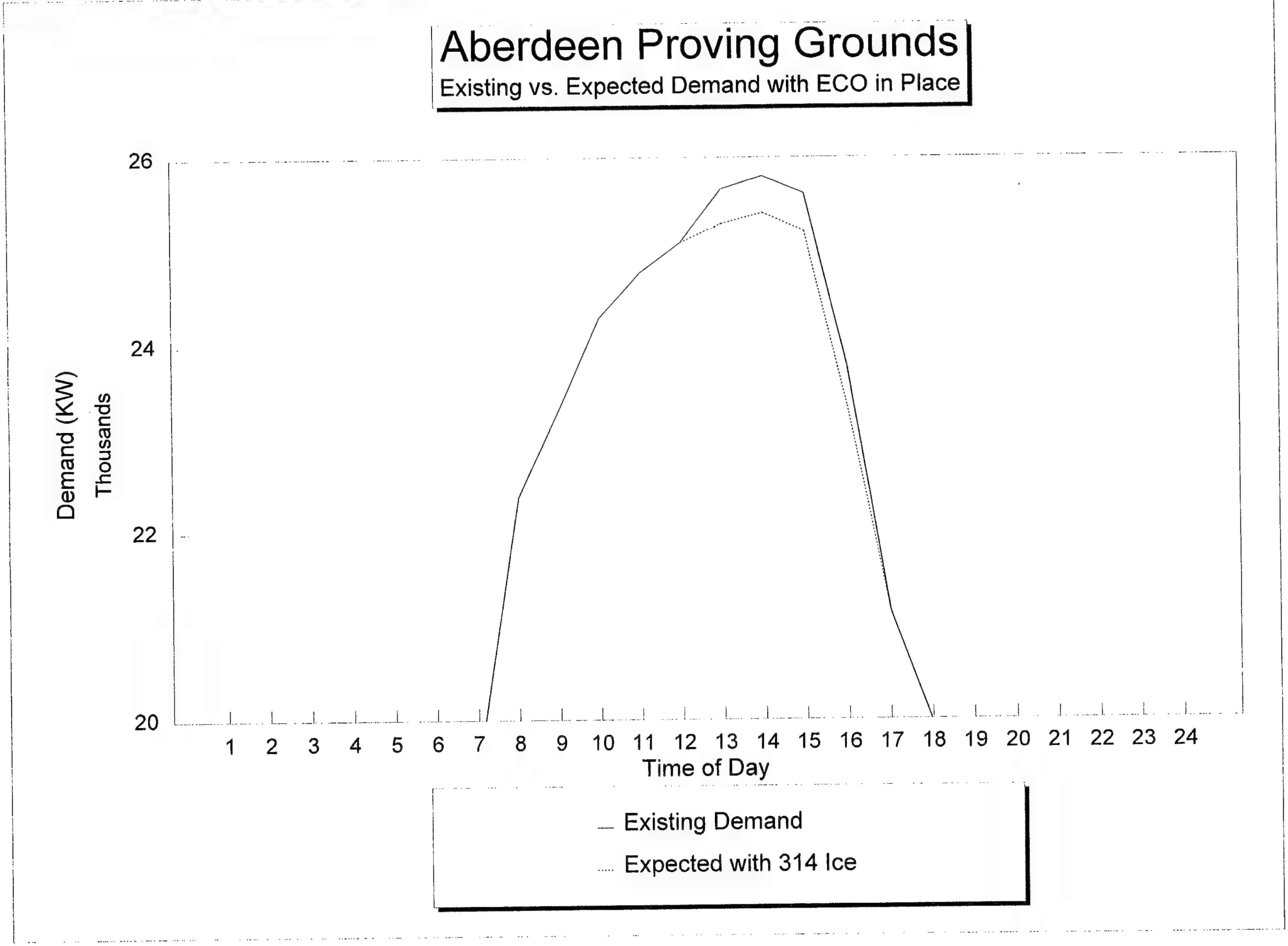
$7,188,015.16

Summary:

	Existing	Proposed
KW	276900	274699
Int. KWH	26300338	26259844
On-Peak KWH	38816152	38688686
Off-Peak KWH	64646510	64845008
Total KWH	129763000	129793538

Mobile - Aberdeen Demand Reduction Study
Building 314 - Ryan Office Building
July Peak Day Cooling Load Profile
100% Storage




Aberdeen Proving Grounds
Existing vs. Expected Demand with ECO in Place
Demand (KW)
Thousands
26
24
22
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time of Day
Existing Demand
Expected with 314 Ice

CONSTRUCTION COST ESTIMATE	DATE PREPARED 23-Apr-96	SHEET 1 OF 1

PROJECT Aberdeen Proving Grounds - Building 314 Ice Storage Aberdeen, MD	BASIS FOR ESTIMATE [X] CODE A (NO DESIGN COMPLETED) [ ] CODE B (PRELIMINARY DESIGN) [ ] CODE C (FINAL DESIGN) [ ] OTHER (SPECIFY)________
LOCATION ENTECH ENGINEERING, INC.	

DRAWING NO.	ESTIMATOR	CHECKED BY
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MECHANICAL SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
Convert Chiller to Ice Duty	1	Lot	$0.00	$0	$5,000.00	$5,000	$5,000
25% Propylene Glycol	200	Gal	$6.95	$1,390	$0.00	$0	$1,390
Glycol/Water Heat Exchanger	1	Ea	$28,000.00	$28,000	$1,400.00	$1,400	$29,400
Ice Storage Tanks	1500	TonHrs	$50.00	$75,000	$20.00	$30,000	$105,000
Concrete Pad	9	CY	$64.20	$590	$30.00	$276	$865
Piping	100	L.F.	$19.45	$1,945	$18.70	$1,870	$3,815
IPipe Insulation	1	Lot	$194.50	$195	$187.00	$187	$382
Valves	4	Ea	$355.00	$1,420	$108.00	$432	$1,852
Controls	1	Lot	$500.00	$500	$1,000.00	$1,000	$1,500
Pumps	2	Ea	$8,250.00	$16,500	$750.00	$1,500	$18,000
Electrical	1	Lot	$6,607.33	$6,607	$2,192.88	$2,193	$8,800
SUBTOTAL				$132,147		$43,858	$176,004
FRINGES @ 28%						$12,280	$12,280
OVERHEAD & PROFIT @ 20%				$26,429		$11,228	$37,657
CONTINGENCY @ 25%				$39,644		$16,841	$56,485
SUPERVISION @ 5%				$9,911		$4,210	$14,121
ENGINEERING @ 15%							$44,000
TOTAL THIS SHEET				$208,000		$88,000	$340,000

ECO-13
Ice Storage for Building 5046

Existing. Building 5046, Pierce Hall/M1 Training, is presently air conditioned by cold water from two 90 hp compressors (120 nominal tons) Trane air cooled reciprocating chiller. According to the Trane Company, this chiller was installed around 1983 and is therefore, over ten years old. This chiller can be converted to ice storage duty, but the Trane Company does not recommend it due to the age of the chiller.

Entech's evaluation of the cooling requirements for the building yielded a peak expected cooling load of 150 tons. This evaluation included heat losses through the building shell, heat loss to the unconditioned weapons work bays, heat gain from equipment and lights, and heat gain from occupants. Miss Gullespie of Aberdeen Proving Grounds, at the request of Sergeant Ely, informed us on February 6, 1996 that the building typically has 190 occupants per day for nine hours per day. This was not an in depth analysis of the building's cooling requirements, but it indicates that the existing equipment may be undersized for this duty.

From the attached sheets, the annual electric demand for the Post is 276,900 kW and usage is 129,763,000 kWh. Annual costs for the Post is $7,200,000. The following table describes existing energy use and costs for the Post based on 1994-1995 electrical data.

Season	*Demand kW*	*Off-Peak kWh*	*Intermediate kWh*	*On-Peak kWh*	*Cost $*
Non-Summer	173,640	42,745,875	17,407,989	21,581,136	$3,882,124
Summer	103,260	21,900,635	8,892,349	17,235,016	$3,336,907
Totals	276,900	64,646,510	26,300,338	38,816,152	$7,219,000

Proposed. Replace the existing chiller with a new chiller sized to meet the expected 150 ton cooling load and capable of ice storage duty. A single ice storage tank would also be purchased to supplement chiller use. Since the objective for this study is to reduce base-wide demand, Entech took an unconventional approach to sizing the ice storage. Peak base demands occur between 1:00 PM and 5:00 PM. Although peak cooling demands are expected to occur around 5:00 PM, the greatest impact on electrical demand is achieved by eliminating electrical use for cooling during the peak demand hours. A single 750 ton-hour ice storage unit can eliminate chiller operation between 1:00 PM and 5:00 PM. The attached figure shows the proposed operating strategy on the design day. On cooler days, the ice storage can be used to satisfy a larger portion of the cooling load. It is advantageous to use as much ice as possible during the utility on-peak period because the cost per kWh is less during the intermediate and off-peak periods. The following table shows expected energy use and costs under the proposed operating strategy. The calculations to support these estimates are included in the attached table.

Season	*Demand kW*	*Off-Peak kWh*	*Intermediate kWh*	*On-Peak kWh*	*Cost $*
Non-Summer	173,312	42,782,948	17,376,616	21,581,135	$3,879,255
Summer	102,626	21,972,325	8,892,352	17,174,356	$3,326,678
Totals	275,938	64,755,273	26,268,968	38,755,491	$7,205,900

Implementation Cost Estimate. The costs associated with this project include purchasing a new 150 ton air-cooled chiller capable of making ice and a single ice storage tank with a 750 ton-hour capacity. The estimated total cost for this project is $343,000.

Materials	$224,000
Labor	$ 74,000
Engineering	$ 45,000

Savings.	The annual cost savings resulting from implementation of this project result from moving demand and electrical usage from the on-peak to off-peak periods is $13,000 ($7,219,000 - $7,205,900 = $13,100, use $13,000). It takes more energy to produce ice than cold water. However, ice is produced during the utility off-peak periods, demand and energy costs are reduced. Refer to attached worksheet for determination of demand and usage costs.

Non-Summer kW	=	328 kW/yr (173,640 kW/yr - 173,312 kW/yr)
Summer kW	=	634 kW/yr (103,260 kW/yr - 102,626 kW/yr)
Off-Peak kWh	=	-108,763 kWh/yr (64,646,510 kWh/yr - 64,755,273 kWh/yr)
Intermediate kWh	=	31,370 kWh/yr (26,300,338 kWh/yr - 26,268,968 kWh/yr)
On-Peak kWh	=	60,661 kWh/yr (38,816,152 kWh/yr - 38,755,491 kWh/yr)
Energy Usage	=	-57 mmBtu/yr ((-108,763 kWh/yr + 31,370 kWh/yr + 60,661 kWh/yr) x 3,413 Btu/kWh) ÷ 1,000,000 Btu/mmBtu

Discussion.	The ECO has a simple payback of 26.4 years ($343,000÷$13,000). The Savings to Investment Ratio (SIR) is 0.5. The LCCID calculation are located in Attachment 8.9. The payback on this ECO is less attractive because the purchase price of the new chiller is included. According to the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), a reciprocating packaged chiller has a median expected life of 20 years. The existing chiller is about 13 years old. The payback for ice storage is more attractive if the chiller had to be replaced today, and the costs associated with the chiller is only the premium paid for the ice making features.

Mobile - Aberdeen Demand Reduction Study
Building 5046 - Pierce Hall/M1 Training
Energy Costs

Existing:

		Demand	
	KW	Unit Cost ($/KW)	Demand Cost
1995 Jan	23400	8.32	$194,688.00
Feb	26400	8.32	$219,648.00
Mar	23400	8.32	$194,688.00
Apr	20940	8.32	$174,220.80
May	21240	8.32	$176,716.80
Jun	24840	14.42	$358,192.80
Jul	27180	14.42	$391,935.60
Aug	26880	14.42	$387,609.60
Sep	24360	14.42	$351,271.20
1994 Oct	17700	8.32	$147,264.00
Nov	19440	8.32	$161,740.80
Dec	21120	8.32	$175,718.40
	276900		$2,933,694.00

Proposed:

	Demand					
	Peak Ton	Chiller Rating (KW/ton)	Delta KW	KW	Unit Cost ($/KW)	Demand Cost
Jan	0	1.1	0	23400	8.32	$194,688.00
Feb	0	1.1	0	26400	8.32	$219,648.00
Mar	0	1.1	0	23400	8.32	$194,688.00
Apr	89	1.1	98	20842	8.32	$173,406.27
May	119	1.1	131	21109	8.32	$175,627.71
Jun	149	1.1	164	24676	14.42	$355,829.36
Jul	149	1.1	164	27016	14.42	$389,572.16
Aug	144	1.1	158	26722	14.42	$385,325.47
Sep	135	1.1	149	24212	14.42	$349,129.83
Oct	90	1.1	99	17601	8.32	$146,440.32
Nov	0	1.1	0	19440	8.32	$161,740.80
Dec	0	1.1	0	21120	8.32	$175,718.40
			963	275938		$2,921,814.33

Intermediate Period Usage

	KWH	Unit Cost ($/KWH)	Intermediate Usage Cost
Jan	2271744	0.034	$77,239.30
Feb	2511655	0.034	$85,396.27
Mar	2288892	0.034	$77,822.33
Apr	1999204	0.034	$67,972.94
May	2277204	0.034	$77,424.94
Jun	2085533	0.040	$83,421.32
Jul	2422091	0.040	$96,883.64
Aug	2366799	0.040	$94,671.96
Sep	2017926	0.040	$80,717.04
Oct	1955178	0.034	$66,476.05
Nov	2091784	0.034	$71,120.66
Dec	2012328	0.034	$68,419.15
	26300338		$947,565.59

Intermediate Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KW	KWH	Unit Cost ($/KWH)	Intermediate Usage Cost
Jan	0	30	0.7	1.1	0	2271744	0.034	$77,239.30
Feb	0	30	0.7	1.1	0	2511655	0.034	$85,396.27
Mar	0	30	0.7	1.1	0	2288892	0.034	$77,822.33
Apr	407	30	0.7	1.1	9402	1989802	0.034	$67,653.28
May	544	30	0.7	1.1	12566	2264638	0.034	$76,997.68
Jun	0	30	0.7	1.1	0	2085533	0.040	$83,421.32
Jul	0	30	0.7	1.1	0	2422091	0.040	$96,883.64
Aug	0	30	0.7	1.1	0	2366799	0.040	$94,671.96
Sep	0	30	0.7	1.1	0	2017926	0.040	$80,717.04
Oct	407	30	0.7	1.1	9402	1945776	0.034	$66,156.39
Nov	0	30	0.7	1.1	0	2091784	0.034	$71,120.66
Dec	0	30	0.7	1.1	0	2012328	0.034	$68,419.15
					31370	26268968		$946,499.01

On-Peak Period Usage

	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	2884895	0.036	$103,856.22
Feb	3233728	0.036	$116,414.21
Mar	2802634	0.036	$100,894.82
Apr	2467763	0.036	$88,839.47
May	2589246	0.036	$93,212.86
Jun	3974633	0.051	$202,706.28
Jul	4802092	0.051	$245,867.11
Aug	4604218	0.051	$235,735.96
Sep	3854073	0.051	$197,328.54
Oct	2346967	0.036	$84,490.81
Nov	2624416	0.036	$94,478.98
Dec	2631487	0.036	$94,733.53
	38816152		$1,658,558.79

On-Peak Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KW	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	0	30	0.7	1.1	0	2884895	0.036	$103,856.22
Feb	0	30	0.7	1.1	0	.3233728	0.036	$116,414.21
Mar	0	30	0.7	1.1	0	2802634	0.036	$100,894.82
Apr	0	30	0.7	1.1	0	2467763	0.036	$88,839.47
May	0	30	0.7	1.1	0	2589246	0.036	$93,212.86
Jun	680	30	0.7	1.1	15708	3958925	0.051	$201,905.18
Jul	681	30	0.7	1.1	15731	4786361	0.051	$245,061.68
Aug	655	30	0.7	1.1	15131	4589088	0.051	$234,961.28
Sep	610	30	0.7	1.1	14091	3839982	0.051	$196,607.08
Oct	0	30	0.7	1.1	0	2346967	0.036	$84,490.81
Nov	0	30	0.7	1.1	0	2624416	0.036	$94,478.98
Dec	0	30	0.7	1.1	0	2631487	0.036	$94,733.53
					60661	38755491		$1,655,456.11

Off-Peak Period Usage

	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	5480361	0.025	$137,009.03
Feb	6528617	0.025	$163,215.43
Mar	5239474	0.025	$130,986.85
Apr	5445033	0.025	$136,125.83
May	4818550	0.025	$120,463.75
Jun	4642834	0.028	$129,999.35
Jul	6455817	0.028	$180,762.88
Aug	5443983	0.028	$152,431.52
Sep	5358001	0.028	$150,024.03
Oct	4197855	0.025	$104,946.38
Nov	4878800	0.025	$121,970.00
Dec	6157185	0.025	$153,929.63
	64646510		$1,681,864.66

Off-Peak Period Usage

	Ton-hours	Days/Month	Diversity	Chiller Rating (KW/ton)	Delta KW	KWH	Unit Cost ($/KWH)	On-Peak Usage Cost
Jan	0	30	0.7	1.3	0	5480361	0.025	$137,009.03
Feb	0	30	0.7	1.3	0	6528617	0.025	$163,215.43
Mar	0	30	0.7	1.3	0	5239474	0.025	$130,986.85
Apr	407	30	0.7	1.3	11111	5456144	0.025	$136,403.60
May	544	30	0.7	1.3	14851	4833401	0.025	$120,835.03
Jun	680	30	0.7	1.3	18564	4661398	0.028	$130,519.14
Jul	681	30	0.7	1.3	18591	6474408	0.028	$181,283.43
Aug	655	30	0.7	1.3	17882	5461865	0.028	$152,932.21
Sep	610	30	0.7	1.3	16653	5374654	0.028	$150,490.31
Oct	407	30	0.7	1.3	11111	4208966	0.025	$105,224.15
Nov	0	30	0.7	1.3	0	4878800	0.025	$121,970.00
Dec	0	30	0.7	1.3	0	6157185	0.025	$153,929.63
					108763	64755273		$1,684,798.80

Existing Total Cost = $2,933,694.00 + $947,565.59 + $1,658,558.79 + $1,681,864.66

$7,221,683.03

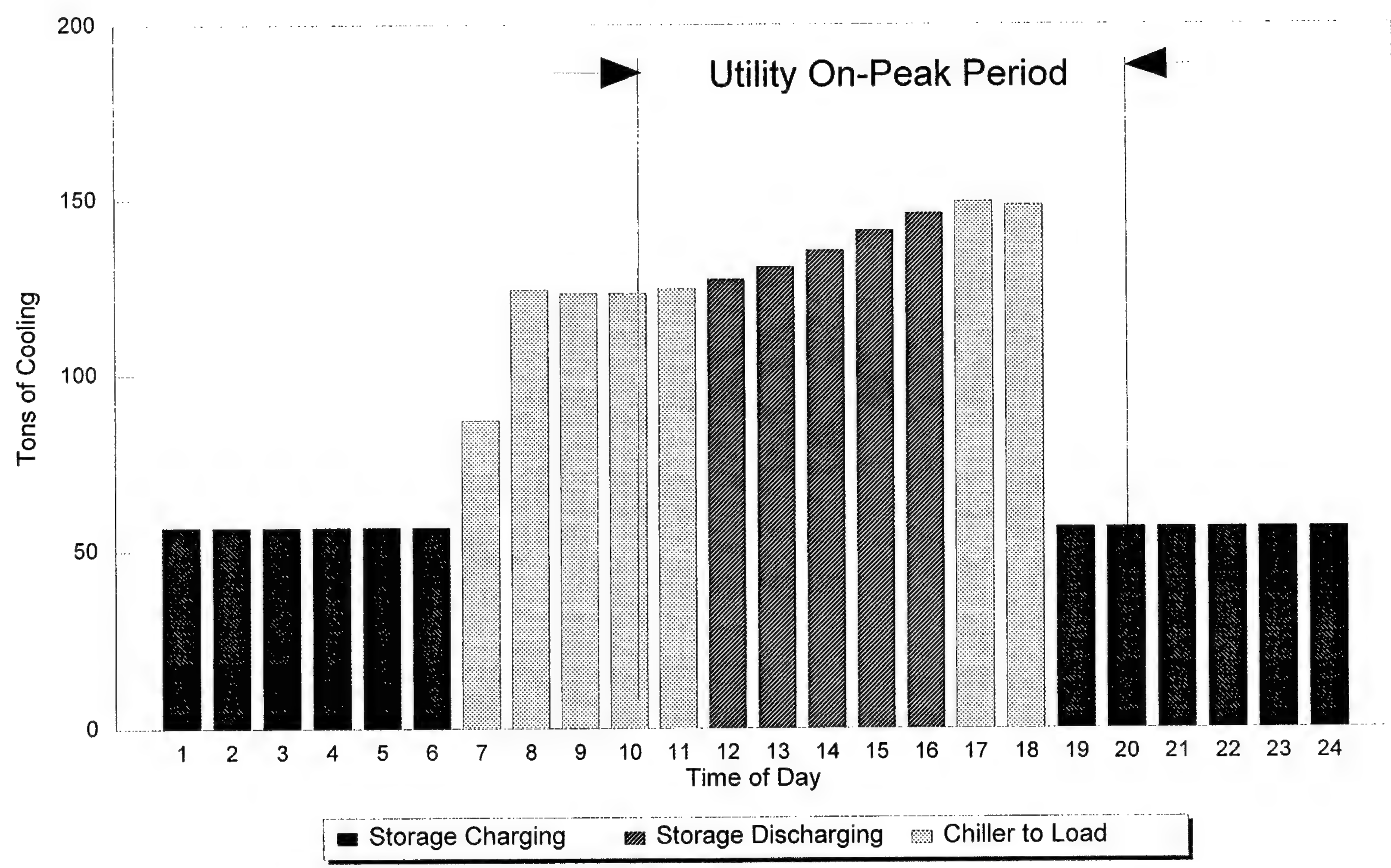
Proposed Total Cost = $2,921,814.33 + $946,499.01 + $1,655,456.11 + $1,684,798.80

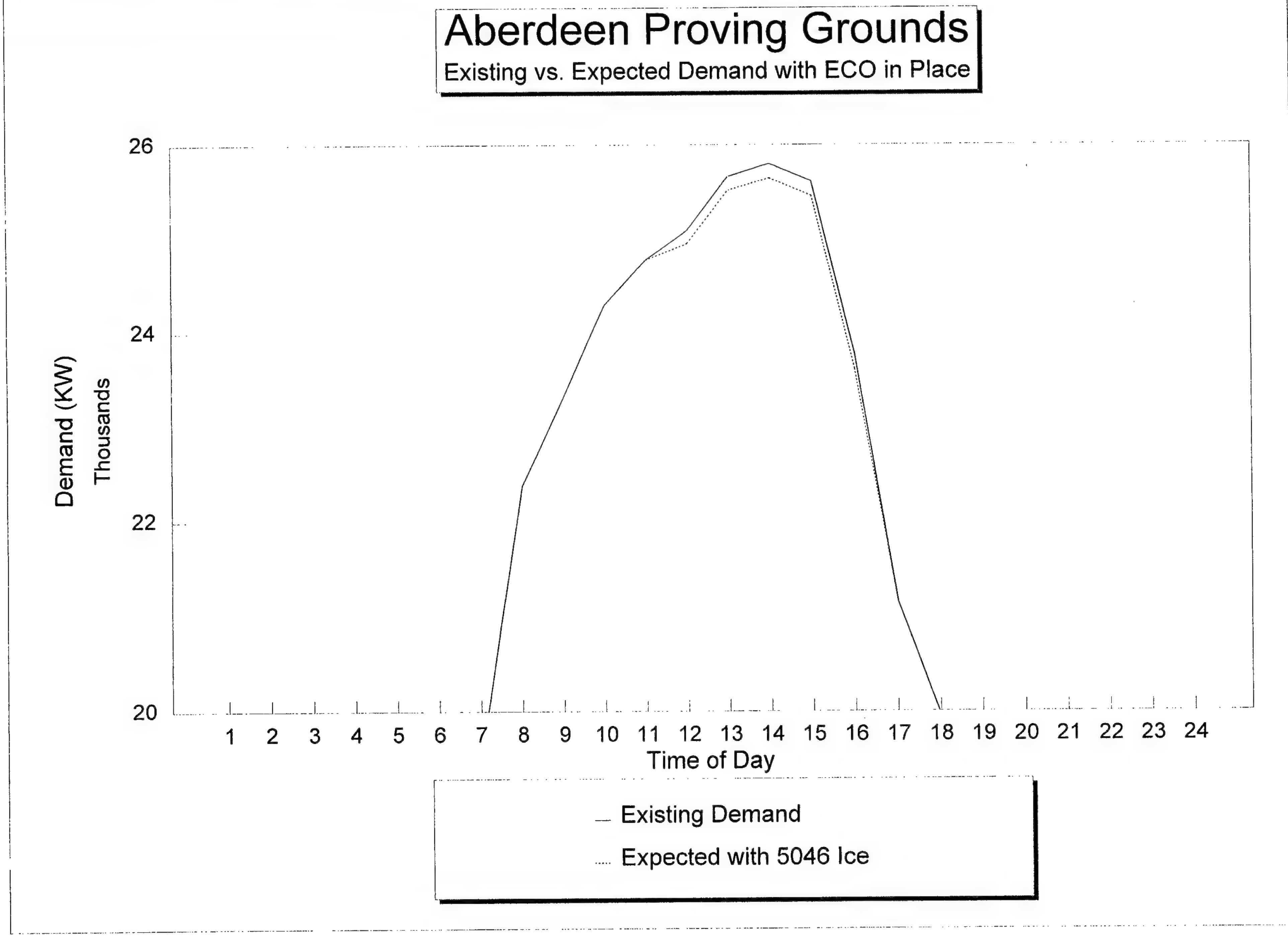
$7,208,568.25

Summary:

	Existing	Proposed
KW	276900	275938
Int. KWH	26300338	26268968
On-Peak KWH	38816152	38755491
Off-Peak KWH	64646510	64755273
Total KWH	129763000	129779733

Mobile - Aberdeen Demand Reduction Study
Building 5046 - Pierce Hall/M1 Training
July Peak Day Cooling Load Profile
100% Storage




Aberdeen Proving Grounds
Existing vs. Expected Demand with ECO in Place
26
24
22
20
Demand (KW)
Thousands
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time of Day
Existing Demand
Expected with 5046 Ice

CONSTRUCTION COST ESTIMATE	DATE PREPARED 23-Apr-96	SHEET 1 OF 1

PROJECT
Aberdeen Proving Grounds - Building 5046 Ice Storage

Aberdeen, MD
LOCATION

BASIS FOR ESTIMATE
[X] CODE A (NO DESIGN COMPLETED)
[ ] CODE B (PRELIMINARY DESIGN)
[ ] CODE C (FINAL DESIGN)
[ ] OTHER (SPECIFY)____________

ENTECH ENGINEERING, INC.
DRAWING NO.
G:\PROJECTS\4130.06\SS\ECOCOSTS.WK

ESTIMATOR
DAE

CHECKED BY

MECHANICAL SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	MATERIAL PER UNIT	MATERIAL TOTAL	LABOR PER UNIT	LABOR TOTAL	TOTAL COST
New 150 ton Chiller, Ice Duty	1	Lot	$67,500.00	$67,500	$13,500.00	$13,500	$81,000
25% Propylene Glycol	100	Gal	$6.95	$695	$0.00	$0	$695
Glycol/Water Heat Exchanger	1	Ea	$10,000.00	$10,000	$500.00	$500	$10,500
Ice Storage Tanks	750	TonHrs	$50.00	$37,500	$20.00	$15,000	$52,500
Concrete Pad	5	CY	$64.20	$289	$30.00	$135	$424
Piping	60	L.F.	$19.45	$1,167	$18.70	$1,122	$2,289
IPipe Insulation	1	Lot	$116.70	$117	$112.20	$112	$229
Valves	4	Ea	$215.00	$860	$87.00	$348	$1,208
Controls	1	Lot	$500.00	$500	$1,000.00	$1,000	$1,500
Pumps	2	Ea	$4,625.00	$9,250	$750.00	$1,500	$10,750
Electrical	1	Lot	$14,208.62	$14,209	$3,690.80	$3,691	$17,899
SUBTOTAL				$142,086		$36,908	$178,994
FRINGES @ 28%						$10,334	$10,334
OVERHEAD & PROFIT @ 20%				$28,417		$9,448	$37,866
CONTINGENCY @ 25%				$42,626		$14,173	$56,799
SUPERVISION @ 5%				$10,656		$3,543	$14,200
ENGINEERING @ 15%							$45,000
TOTAL THIS SHEET				$224,000		$74,000	$343,000

6.3 ECOs Considered but Not Evaluated

In addition to ECOs listed in Section 6.2 of this report, a few ECOs were considered but dismissed based on poor preliminary economics or technical concerns. The following are brief listings of ECOs considered but not evaluated.

Post Hours of Operation. Changing the work schedules of the personnel on Base, from a nine (9) day bi-week to some other model involved too many assumptions to provide reliable results.

Modifying Building 3660 Cold/Dry Storage Design. The layout of the building with respect to orientation initially appears to be questionable. The freezer is located in the west corner of the building, the area with the largest impact from solar gain. The investment in a service corridor, however, insulates the freezer from the outside wall and minimizes the impact of the sun.

Effectiveness of the vapor barrier could not be determined from information provided by Aberdeen.

A potential area for savings is the defrost cycle. The defrost cycle for most of the cool storage areas is activated by a time clock and terminated by temperature. The operation time of day could be examined for its impact on demand and electrical costs. Only the onions and potatoes area (55° F to 60 °F) and the hardy vegetable and fruit area (40 °F to 45 °F) have defrost cycles that are time initiated and time terminated. Trial and error could be used to try to reduce defrost operation in areas where the defrost cycle is completely

controlled by a time clock. The impact of time of day operation can also be evaluated in these areas.

At the time of our visits to the site in January 1996, the building was barely being utilized. The freezer and cool storage areas were cooled to their design temperatures, but only a small amount of product, or no product, was present in each of the cool areas. A cold storage facility operates most efficiently when it is full of product. The product stored aids in maintaining cold temperatures and air circulation is reduced when racks are filled.

7.0 CONCLUSION

7.1 General

A summary of all fourteen (14) ECOs are shown in the order presented in Section 6 on the following page in Table 7.1.1. Included with each alternative are annual cost savings, annual maintenance savings/costs, annual energy savings, construction costs, simple payback period, and Savings to Investment Ration (SIR).

The lists of the recommended or not recommended ECOs are shown in the following sections. In addition to the summary information for each ECO a comment is added to each ECO in the two lists which relates to Entech's opinion on which category the project falls under. Below is the criteria that is used to categorize the report's findings (ie. ECIP, Non-ECIP etc.). The following criteria is the basis to recommend or not-recommend ECOs for this report. The criteria is from the scope for this project which is included in Attachment 8.11.

TABLE 7.1.1
ECO SUMMARY, NO INTERACTION

ECO		Electricity				Natural Gas			Fuel Oil			Annual Totals					
RECOMMENDED ECOs																	
ECO #	Description	Demand kW	Usage kWh	Cost	mmBtu	Usage mcf	Cost $	mmBtu	Usage gal	Cost $	mmBtu	mmBtu	Total Cost	Maint. Savings	Const. Cost	Payback Period	SIR
1	New 115 kV Substation - 2 Transformers	0	(1,297,630)	$600,000	(4,429	0	$0	0	0	$0	0	(4,429)	$600,000	($15,000)	$4,100,000	7.0	1.9
1A	New 115 kV Substation - 1 Transformer	0	(1,297,630)	$600,000	(4,429	0	$0	0	0	$0	0	(4,429)	$600,000	($15,000)	$2,700,000	4.6	2.9
2	Upgrading Substations 4 & 9	0	0	$140,000	0	0	$0	0	0	$0	0	0	$140,000	$0	$520,000	3.7	3.6
3	Upgrading Substation 18	0	0	$350,000	0	0	$0	0	0	$0	0	0	$350,000	$0	$1,500,000	4.3	3.1
4	Emergency Generation Rider	350	42,000	$18,400	143	(291)	($1,500)	(300	(1,280)	($900)	(178	(334)	$16,000	($4,300)	$0	0.0	N/A
5	BG&E's Curtailment Service Rider	0	600,000	$1,800,000	2,048	0	$0	0	(49,200)	($30,000)	(6,824	(4,776)	$1,800,000	$0	$4,900,000	2.7	4.9
6	Peak Shaving with Emergency Generators	1,400	308,000	$32,600	1,051	(2,136)	($11,200)	(2,202	(9,384)	($6,600)	(1,302	(2,453)	$14,800	$0	$1,100	0.1	111.1
7	Electric Clothes Dryers to Natural Gas	680	368,620	$19,300	1,258	(1,745)	($9,200)	(1,799	0	$0	0	(541)	$10,100	$0	$79,000	7.8	1.3
8	Disable or Redirect Sensor for Doors	0	675	$30	2	0	$0	0	0	$0	0	2	$30	$0	$240	8.0	1.7
9	Limit Use of Freezer Underfloor Warming	52	37,856	$1,800	129	0	$0	0	0	$0	0	129	$1,800	$0	$0	0.0	N/A
10	Electric Clothes Dryers to Gas - New Drye	680	368,620	$19,300	1,258	(1,745)	($9,200)	(1,799	0	$0	0	(541)	$10,100	$0	$177,000	17.5	0.6
11	Add Insulation to Exterior Freezer Wall	3	1,820	$100	6	0	$0	0	0	$0	0	6	$100	$0	$10,500	105.0	0.1
12	Building 314 Ice Storage System	2,201	(30,538)	$30,000	(104	0	$0	0	0	$0	0	(104)	$30,000	$0	$340,000	11.3	1.2
13	Building 5046 Ice Storage System	962	(16,732)	$13,000	(57	0	$0	0	0	$0	0	(57)	$13,000	$0	$343,000	26.4	0.1

Recommended ECIP Projects: To qualify for an ECIP project, an ECO or group of ECOs must have a construction cost greater than $300,000. In addition, a simple payback period of less than 10 years and an SIR greater than 1.25 must be achieved. Presently there are two (2) recommended ECOs which would qualify for ECIP funding.

Recommended Non-ECIP General Projects: These are ECOs which do not meet the construction cost and payback period criteria, but have an SIR greater than 1.25. There is only one (1) ECO which falls into this category.

Recommended Non-ECIP O&M Projects: An O&M Energy Project is one that results in needed maintenance and repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings. No ECOs have be recommended for this category.

Recommended Non-ECIP Low Cost/No Cost - Projects: The Base can implement with their own resources. There are three (3) recommended ECOs that fall into this category.

Non-Feasible: ECOs that are not recommended based on findings for ECIP, Non-ECIP, and O&M, or because of reasons stated in the individual ECO discussion section and/or the not recommended table. There are eight (8) ECOs which are not feasible to be implemented.

7.2 Recommended ECOs

Of the fourteen (14) Energy Conservation Opportunities (ECOs) addressed, six (6) have been found to be acceptable, and they are listed in Table 7.2.1. Included with each ECO are annual cost savings, annual maintenance savings/costs, annual energy savings, construction costs, simple payback period, and Savings to Investment Ration (SIR).

#	*ECO Description*	*Comment*
1	New 115 kV Substation - 2 Transformers	ECIP
5	BG&E's Curtailment Service Rider	ECIP
6	Peak Shaving with Emergency Generators	Non-ECIP LC/NC
7	Electric Clothes Dryers to Natural Gas	Non-ECIP
8	Disable or Redirect Sensor for Doors	Non-ECIP LC/NC
9	Limit Use of Freezer Underfloor Warming	Non-ECIP LC/NC

TABLE 7.2.1
RECOMMENDED ECO SUMMARY, NO INTERACTION

RECOMMENDED ECOs

ECO		Electricity				Natural Gas			Fuel Oil			Annual Totals					
#	Description	Demand kW	Usage kWh	Cost	mmBtu	Usage mcf	Cost $	mmBtu	Usage gal	Cost $	mmBtu	mmBtu	Total Cost	Maint. Savings	Const. Cost	Payback Period	SIR
1	New 115 kV Substation - 2 Transformers	0	(1,297,630)	$600,000	(4,429	0	$0	0	0	$0	0	(4,429)	$600,000	($15,000)	$4,100,000	7.0	1.9
5	BG&E's Curtailment Service Rider	0	600,000	$1,800,000	2,048	0	$0	0	(49,200)	($30,000)	(6,824	(4,776	$1,800,000	$0	$4,900,000	2.7	4.9
6	Peak Shaving with Emergency Generators	1,400	308,000	$32,600	1,051	(2,136)	($11,200)	(2,202	(9,384)	($6,600)	(1,302	(2,453)	$14,800	$0	$1,100	0.1	111.1
7	Electric Clothes Dryers to Natural Gas	680	368,620	$19,300	1,258	(1,745)	($9,200)	(1,799	0	$0	0	(541)	$10,100	$0	$79,000	7.8	1.3
8	Disable or Redirect Sensor for Doors	0	675	$30	2	0	$0	0	0	$0	0	2	$30	$0	$240	8.0	1.7
9	Limit Use of Freezer Underfloor Warming	52	37,856	$1,800	129	0	$0	0	0	$0	0	129	$1,800	$0	$0	0.0	N/A

Entech Engineering, Inc. 01-May-96

7.3 Non-Recommended ECOs

Eight (8) Energy Conservation Opportunities (ECOs) out of the original fourteen (14) are not-recommended for implementation. Those ECOs were not recommended ECOs for various reasons including the criteria in Section 6.1. The not-recommended are listed in Table 7.3.1. Included with each ECO are annual cost savings, annual maintenance savings/costs, annual energy savings, construction costs, simple payback period, and Savings to Investment Ration (SIR).

#	*ECO Description*	*Comment*
1A	New 115 kV Substation - 1 Transformer	ECIP
2	Upgrading Substations 4 & 9	Non-ECIP O&M
3	Upgrading Substation 18	Non-ECIP O&M
4	Emergency Generation Rider	Non-ECIP LC/NC
10	Electric Dryers to Gas - Includes New Dryers	Non-Feasible
11	Add Insulation to Exterior Freezer Wall	Non-Feasible
12	Building 314 Ice Storage System	Non-Feasible
13	Building 5046 Ice Storage System	Non-Feasible

ECO-1A is not recommended because ECO-1 has a higher level of reliability. ECOs 2 and 3 are not recommended because they interact with ECO-1. Also ECOs 2 and 3 only reduce the distribution demand charge in half, while ECO-1 eliminates the entire charge. ECO-4 is not recommended due to ECO-6 having a better payback and a higher SIR. ECOs 10, 11, 12, and 13 are not feasible due to paybacks over 10 years.

TABLE 7.3.2
NON-RECOMMENDED ECO SUMMARY, NO INTERACTION

ECO #	Description	Electricity Demand kW	Electricity Usage kWh	Electricity Cost	Electricity mmBtu	Natural Gas Usage mcf	Natural Gas Cost $	Natural Gas mmBtu	Fuel Oil Usage gal	Fuel Oil Cost $	Fuel Oil mmBtu	Annual Totals mmBtu	Annual Totals Total Cost	Annual Totals Maint. Savings	Annual Totals Const. Cost	Annual Totals Payback Period	Annual Totals SIR
RECOMMENDED ECOs																	
1A	New 115 kV Substation - 1 Transformer	0	(1,297,630)	$600,000	(4,429	0	$0	0	0	$0	0	(4,429)	$600,000	($15,000)	$2,700,000	4.6	2.9
2	Upgrading Substations 4 & 9	0	0	$140,000	0	0	$0	0	0	$0	0	0	$140,000	$0	$520,000	3.7	3.6
3	Upgrading Substation 18	0	0	$350,000	0	0	$0	0	0	$0	0	0	$350,000	$0	$1,500,000	4.3	3.1
4	Emergency Generation Rider	350	42,000	$18,400	143	(291)	($1,500)	(300	(1,280)	($900)	(178	(334)	$16,000	($4,300)	$0	0.0	N/A
10	Electric Clothes Dryers to Gas - New Drye	680	368,620	$19,300	1,258	(1,745)	($9,200)	(1,799	0	$0	0	(541)	$10,100	$0	$177,000	17.5	0.6
11	Add Insulation to Exterior Freezer Wall	3	1,820	$100	6	0	$0	0	0	$0	0	6	$100	$0	$10,500	105.0	0.1
12	Building 314 Ice Storage System	2,201	(30,538)	$30,000	(104	0	$0	0	0	$0	0	(104)	$30,000	$0	$340,000	11.3	1.2
13	Building 5046 Ice Storage System	962	(16,732)	$13,000	(57	0	$0	0	0	$0	0	(57)	$13,000	$0	$343,000	26.4	0.1